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The Thomson-Houston Electric Lighting System.

ITS PECULIAR FEATURES—ITS PHENOMENAL SUCCESS—SKETCHES OF ITS ORIGINATOR—PRESENT MANAGEMENT.

The field of electric arc lighting has within five years shown several successful contestants for popular favor, as well as many whose lease of life has proved as transitory as the scintillations of auroral streamers. Comparatively few of all the systems of America and the Old World have demonstrated their adaptation to the practical needs of business, and a still smaller number can be said to have secured to their inventors and promoters any profitable return.

It is a pleasure to be able to chronicle decided progress in a department of illuminating work where multitudes of difficulties bar the path of the experimenter, and where complication of apparatus is equivalent to annihilation of commercial prosperity.

It is but a few months since the Thomson-Houston light was shown in Boston at the

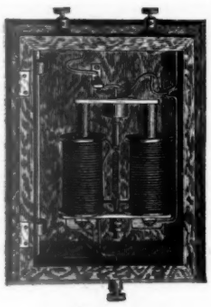

FIG. 3.

last exhibition of the Manufacturers' and Mechanics' Institute. Much attention was then attracted because of the novel construction of the generator and the steadiness of the lights which was unequaled by other arc lamps in the exhibition.

This interest was renewed and intensified by the establishing somewhat later of a station in the basement of the Mechanics' Charitable Association building and the appearance of the lamps on the street, commanding attention by the beautiful diffusions from their small opal globes and the absence of the flicker, hiss and uncertainty of others among which they were placed.

Added to these advantageous features, which at once appealed powerfully to those desiring electricity in stores and offices, was the further consideration of cheaper service, made possible, according to the claims of the company formed for its introduction by the simplicity and relatively low first cost of the apparatus and the reduced power necessarily expended in its operation.

The little system at Lynn, which had been for sometime satisfactorily worked, was visited by numbers whose inquiries resulted in several instances in an investment in the Boston enterprise, as well as in the parent company, then known as the "American." The latter corporation have recently established as their business headquarters an office in the Rialto Building, Boston, called a manager from Lynn to take charge of their rapidly growing interests, and changed their style to an embodiment of the names of the well-known inventors and electricians, Profs. Thomson and Houston. Their reasons for this step are set forth in their recent circular-letter to their patrons and the public, which we copy below:

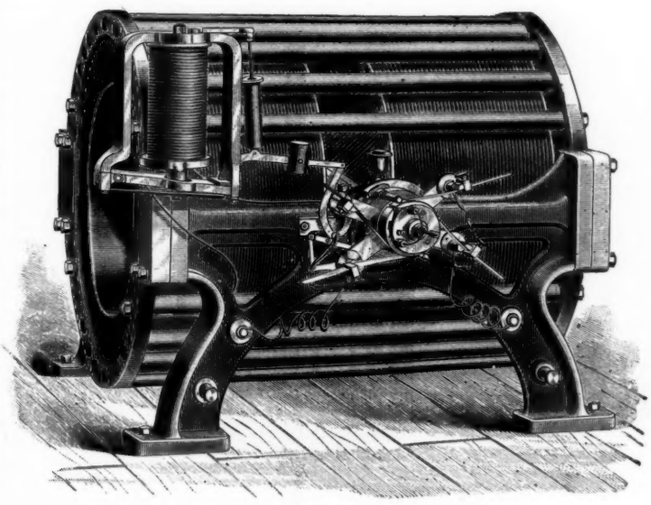

FIG. 1.

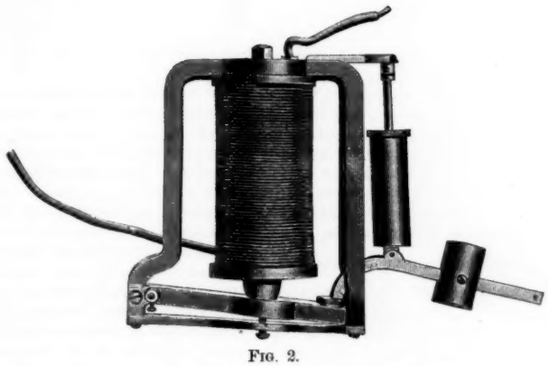

FIG. 2.

BOSTON, April 26, 1883.

"The Directors of the American Electric Company of New Britain, Conn., desiring to avoid any complications liable to arise from the fact that there are in the United States several American Electric or American Electric lighting companies have decided to change the name of the corporation.

Desiring to compliment the inventors, as well as to retain the name by which the system is already quite generally known, the company will hereafter, under the provisions of a special legislative charter, be known as the Thomson-Houston Electric Company."

The present capital of this corporation is $125,000, and its officers are as follows:

President—Henry A. Pevear.

Vice-President—C. A. Coffin.

Treasurer and General Manager—S. A. Barton.

Secretary—J. J. Skinner.

Electrician—Elihu Thomson.

Directors—H. A. Pevear, C. A. Coffin, J. N. Smith, Elihu Thomson, S. A. Barton, B. F. Spinney.

In connection with a somewhat careful examination of the peculiar electrical machinery represented by this young and vigorous company, it will be found of interest to mention some of the

EARLY INVESTIGATIONS

leading up to the perfected system of to-day. In the *Scientific American*, in the fall of 1879, and afterward (November 22, 1879) in the London *Electrician*, appeared a long criticism upon the "Edison Electrical Generator," by Dr. Charles Seeley, of New York, in which occurred the following paragraph:

"In 1877 a committee of the Franklin Institute, of Philadelphia, consisting of ten competent and eminent experts, with a view of determining the capabilities of electrical generators, made a series of trials with the best machines then procurable. Their elaborate report, describing the details of experiments, was published in the May and June numbers of the *Institute Journal*, of 1878. This report has become a recognized authority, and remains, so far as I know, in all respects unimpeached, and I shall use it now with the fullest confidence in the accuracy of its statements."

Dr. Seeley quoted freely for his purpose.

This series of comparative scientific tests was the first ever attempted in this field, and was made in recognition, by the members of the institute, of the importance which the subject of the development and application of heavy currents of electricity had come to assume. The greater part of the work of the committee, and all relating to electrical measurements, fell to the lot of Professors Elihu Thomson and Edwin J. Houston, then occupying the chairs of chemistry and natural philosophy in the Central High School of Philadelphia. In the line of their professional work, and as members of the institute, these gentlemen had for a number of years given close attention to the rapid progress in the world of electrical science, and had occupied themselves with the solution of some of its problems.

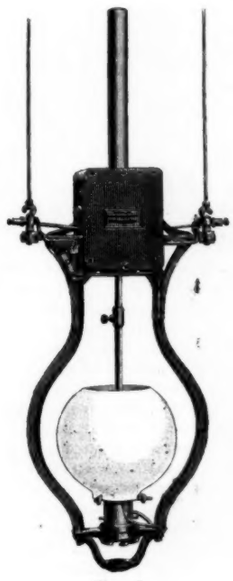

FIG. 4.

The labors of this pioneer investigating committee extended over a period of several months, and the influence upon the associated professors was to greatly increase their previous interest and incite them to more zealous efforts. Results of their tests and inquiries had previously, and have since, appeared from time to time in papers prepared jointly by them, read before scientific societies, and widely copied and noticed in the electrical publications of this country and Europe, greatly assisting in providing a safe basis from which to estimate the real merits and commercial value of the electric light. Taken in connection with the report alluded to, these papers form valuable literature for the student of electrical engineering, and a

partial list of them is here given, with the dates at which they were published in the *Journal of the Franklin Institute:* "Phenomena of Induction," January, 1876; "Circumstances Influencing the Efficiency of Dynamo-Electric Machines," February, 1878; "Transmission of Power by Means of Electricity," January, 1879; "A Curious Thermo-Magnetic Motor," January, 1879; "Induction Apparatus for Reversed Currents," January, 1879; "The Reaction Principle of Dynamo-Electric Machines," July, 1879; "The Electric Arc—Its Resistance and Illuminating Power," July, 1879; "A System of Electric Storage," December, 1879.

Possessing thus a thorough knowledge of the principles of electrical science, gained by the study and experience of years, well knowing what had been done by others, and enjoying the advantage of the institute's fine electrical and chemical laboratory and the store of standard and current literature afforded by its library, Professors Thomson and Houston were able to devise and perfect

A COMPLETE SYSTEM

of dynamos, lamps and regulators, perhaps unequaled in value for the purposes of arc lighting. Their early patents bear dates of September 2, October 7, and October 14, 1879; January 13 and January 20, 1880, and cover the essential features which make their machinery unique and reliable. Drawing upon the Gramme inventions for the fundamental principles of their dynamos, their company has united with the syndicate forming the Gramme combination, and is rapidly working to the front as among its strongest factors.

THE THOMSON SPHERICAL GENERATOR,

as it is called, from the nearly spherical form of its armature, differs radically from all others in several essential points, viz., its field magnets, armature, winding and commutator. In addition, it is provided with an automatic regulator, an attachment not applied to any other form of generator for arc lighting now in common use.

In the exciter for his large dynamo, Hiram S. Maxim has introduced a complicated system of electro-magnets, ratchets and bevel gearing, intended to automatically change the position of his single brushes from the point of least to that of greatest efficiency; but the contrast between the methods of the operation and delicacy of adjustment preclude any just comparison as to the relative efficiency of the two devices.

The view of the complete generator given in Figure 1 will convey an idea of the general appearance and disposition of its parts. The armature, which is almost hidden by the pole-pieces, is made internally of a hollow shell of soft iron, secured to the central portion of the shaft between the bearings, and is wound externally with three copper wires, varying in size, with the power of the different machines, from 10 to 13 gauge, with double cotton insulation. These three wires are wound in alternating coils or helices, a layer of the first, then second, then third being successively placed in position longitudinally on the core, each band occupying in width 120° of its equatorial circumference. Additional layers to any required number are similarly added, and their internal ends having been permanently joined, the three coils act, in reality, as a single three-branched wire, the three free ends being carried through the hollow shaft to the commutator.

The entire armature is exposed to an intense magnetic field, the pole-pieces being double-concave shells of cast iron, carefully adjusted with reference to the revolving sphere within so as to leave the smallest intervening air-space consistent with safety at high speed, and connected externally by rods forming the magnet bars. These heavy bars also serve as a protection to the wire of the field coils, insuring greater safety in transportation and protection from injury through the development of excessive centrifugal force. If balanced with care, the revolution of the armature is very uniform, while from its shape the loss of power by air friction is reduced to a minimum, and its coils running almost without heat, are kept perfectly cool by an active circulation of air between the space separating the pole-pieces and circular openings in the center of their concave discs. As will be plain from the illustration, the field coils are wound on the circumference of these double-concave pole-pieces, and being connected always in the main circuit, use the entire force of the current in intensifying the magnets near the points of greatest efficiency. The tubular shaft is of steel, revolving in long babbitted bearings sustained by a heavy iron frame. No special foundation is ordinarily required.

The commutator, mounted at the end of the shaft, consists of three segments only, which aside from being supported between two circular flanges, (each 4 inches in diameter and ¼ inch thick) covered with hard rubber, are separated by unusually wide air spaces (nearly ¼ inch) and form a hollow cylinder with more than half an inch of air space around the central shaft. They are connected with the free ends of the three armature coils, as seen in the figure. Their construction and method of attachment allow their ready removal for cleaning or replacement. Power is applied to a pulley at the end of the shaft not shown in the engraving. The brushes are of the usual style employed on machines of small quantity and high electro-motive force, about 1½ inches wide and of the thickness of stiff card-board,

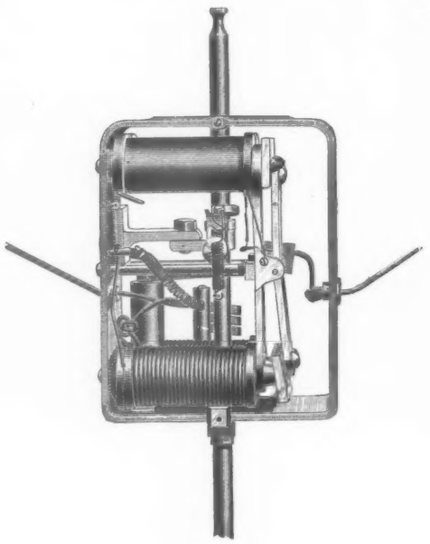

FIG. 5.

having several teeth or fingers. They are perhaps somewhat lighter than other arc light machines, and this is compensated for by the employment of two for each pole, secured by an adjustable holder so as to include an arc of the commutator circumference. This brings us to another of the salient features of this system, the

AUTOMATIC CURRENT REGULATOR.

Like all devices of reliable and efficient character, this attachment is exceedingly simple in its operation. In Fig. 1, it is seen in its place on the framework at the left end of the dynamo, and Fig. 2 shows somewhat more clearly the construction of its magnet. The helix is wound with the size of wire used in the field coils, (½ ohm total resistance) and forms a part of the working circuit. Its lower and active pole is paraboloidal in form and encircled by a perforated armature, which has a metallic connection with the framework and core of the magnet, and really forms its opposite pole. It is connected with a lever bearing a sliding weight, and attached to the adjustable brush holders. These act under its slightest impulse like a pair of shears, separating or drawing together each pair of brushes, which are insulated from the holder rods, and electrically connected by flexible conductors, the one giving the lower E. M. F. being so arranged as to move through an arc perhaps three times that covered by the other, while both have at the same time a secondary motion in the same direction.

Now suppose the armature in Fig. 1 to be set in motion, in the direction opposite to the movement of the hands of a watch. A perpendicular through the center of the commutator would separate the brushes into pairs, of which those on the left are positive. The first pulsations of the current are taken up by the two left-hand brushes, the upper one, being farthest from the point of greatest efficiency on the commutator, taking a less intense current, but both receiving a like polarity, and though absorbing different degrees of electro-motive force, joining their currents to work in harmony in the left or positive field magnet coil, through which they are next directed, and from which they are connected through the helix of the regulator to line, returning through the negative field coil to the negative brushes. As the speed increases, and the field magnets gain their maximum intensity, the regulator asserts its power, draws the armature up until the brushes receding from each other and at the same time from the point of maximum attraction, deliver such a current as the resistance in the exterior circuit demands. So long as the requirement remains constant, the power of the regulator magnet will support the adjusted weight and maintain the position of the brushes. But now suppose several lights to be suddenly switched into the circuit. The resistance is largely increased, the intensity of the current is diminished, and a higher E. M. F. is called for. Instantly the regulator magnet loses in energy, the armature drops, the associated brushes move toward each other and the point of greatest efficiency, the increase of current strength exerts a powerful influence on the regulator magnet, the armature again rises, and with one or two gentle oscillations settles at the point of pressure required to satisfy the new conditions. This vibratory action is modified by a dash-pot filled with glycerine, shown in the figure, which prevents any too impulsive movement and consequent sudden change of current strength. A peculiar advantage is also gained by the use of the paraboloidal pole, securing a uniform attraction of the polarized armature in different positions, the greatest possible force simply serving to hold the armature midway of the length of the projecting pole-piece, without touching either the magnet or the spool. Hence all tendency to sticking or catching is avoided.

In connection with the larger generators

A CONTROLLER

of the amount of current passing through the regulator is used, making the automatic apparatus still more sensitive. Its form is shown in Fig. 3. Here the whole line current enters the screw cup at the top, passes successively through the right and left-hand coils of the low resistance, double axial magnet and is divided at the lower left-hand cup, one path connecting with the regulator, the other with the top of a carbon rod, shown in the right-hand corner, from its base to the right-hand cup and thence to the wire beyond the regulator.

Now, when the intensity falls below a given strength, both the regulator and carbon rod are instantly shunted from the circuit through a track of no resistance completed by the fall of the controller armature, bringing a point thereon connected by a flexible loop with the left-hand post, to a contact spring in communication with the one at the right, thus releasing the regulator armature, suddenly bringing the brushes toward the "strong point," when the whole action is reversed, the short circuit broken and regulator and carbon again divide the attention of the current. As these changes occur with almost lightning-like rapidity, the balance is so nicely kept up that the current seems as it were circumscribed at every point to the exact efficiency desired.

On the other hand, it will be seen that acting universely any variation in the speed of the dynamo can in no way affect the exterior circuit. Instances have arisen where in mills a variation from 900 to 1,300 revolutions during short invervals was not perceptible in the lamps.

The advantage of this perfect control may not at first glance fully appear. For by this means not only is the power of the generator adapted to run any number of lights within its capacity, but it may be short-circuited purposely or by accident without damage, as shown by a number of instances where complete protection was realized. In one case four generators in series, representing over forty lamps capacity, were accidently short-circuited. No injury or even noticeable action took place, except a quick movement of the regulators in adapting themselves to the new circumstances. To a generator unprovided with some similar device great injury or possible destruction would result. On a recent occasion at the turning off of ten lamps from a 28-light circuit at a specified moment, the E. M. F. not only dropped in the necessary degree, but while maintaining the same number of revolutions the power absorbed from the engine was shown to be proportionately reduced.

In some systems, as is well known, the dynamo must always grind out its full capacity of current, and the extinguishing of lamps must be compensated for by introducing coils of equal resistance into the circuit, wasting expensive power and necessitating constant watchfulness of attendants, lest the machines destroy themselves by the energy of their own currents.

ABSENCE OF HEAVY SPARKING.

It has often been mentioned that this generator works almost without sparking. This is largely due to the system of double brushes, which invariably make contact with a segment yielding low E. M. F., before breaking with one giving a higher pressure. As the wide breach between segments is thus always bridged when sparks are most likely to occur, there is no violent break in the continuity of the current, the effect even with so small a number of coils being similar to that produced in earlier machines whose commutator blocks were cut spirally or diagonally, allowing each brush to cover two or more of them. But another excellent device which greatly assists in this regard is the

INSULATING BLAST.

Between the armature and bearing, on the commutator end of the shaft and rotating with it, is placed a wheel having three fingers or fans, which under pressure sink into its circumference. Enclosing this wheel and fastened to the frame of the machine, is a stationary box, whose interior space is elliptical in form, and whose shortest diameter corresponds to that of the enclosed wheel, leaving two empty spaces, from which by means of the fans currents of air are projected through apertures in small pipes directly in front of the brushes

carrying the highest intensity. This air blast keeps the segments and brush points cool, prevents the deposit of fine metal dust which would settle upon insulated portions, and by its force severs any arc which may chance to form, and reduces the trimming of brushes to a minimum. In actual practice this is usually required but once in two or three weeks, and one instance is on record where in the Lynn station, one set of brushes was used steadily six hours a day during a period of four months without alteration. This phenomenal result is undoubtedly largely due to the profuse lubrication which is made possible without injury, and an auxiliary device for the even distribution of oil on the commutator, the air blast insuring an automatic delivery from an ordinary oil cup. While in the case of other high tension machines, only a slightly oiled woolen cloth can be carefully passed over the surface, the entire contents of an oil-can have in more than one instance been upset upon this commutator with no unusual flashing.

The dynamos are made in six sizes for 3, 4, 10, 12, 20 and 28 lamps, and the speed varies from 1,200 revolutions in the smaller sizes to 850 in the heaviest. The largest do not exceed in number of parts those of less capacity.

The internal resistance of a 28-light machine is 18 ohms, which is equally divided between the armature and field coils. The E. M. F. is closely similar to that of the Brush, being from 45 to 50 volts per lamp, so that the largest dynamos gives a current of 1,260 volts and an intensity of 9.6 ampères.

One of the most important and interesting of the many features is the amount of power absorbed. Official measurements have in some instances given surprising results. One trial in Montreal, when all circumstances seemed to conspire toward economy, showed 27 lamps operated by 16½ indicated horse-power. Under ordinary conditions 26 lamps require 17 to 19 horse-power or .69 horse-power per lamp.

A STEADY CURRENT.

As will be understood from the foregoing descriptions the small number of commutator segments, the compensating action of the brushes and the balancing influence of the regulator and field coils combine to reduce the frequency and violence of the pulsations emanating from the armature, until as sent to line the ninety fluctuations or tremors per second given by an average machine do not individually exceed 10 per cent. of the total current strength.

Hence, though its E. M. F. stands among the highest, the current of the Thomson-Houston dynamo has very little of that pulsatory character which has proved so deadly, and no serious accident by its means are chronicled.

It is easy to get a shock of some severity at the brushes of a small machine, but there is comparatively little felt at the binding posts when connected through the arms and body. As in this case the total external resistance (say 10 lamps and circuit wire) would not ordinarily exceed 100 ohms, while the resistance of the human body is from 4,000 to 6,000 ohms, but a small proportion (say 2 per cent.) is applied to the nerves, and this so steady as to occasion no inconvenience This feature, the greater safety of nearly constant, as contrasted with pulsatory and alternating currents, is being recently appreciated, and important modifications may be expected in those systems which are most open to objection in this regard.

THE LAMP

which contributes by its regularity of action so much to the efficiency of this system, consists outwardly of a graceful iron frame having curved sides, and a small case for regulating mechanism. Fig. 4 will give a well-defined idea of the distinctive appearance of this lamp, and enable the reader to recognize it wherever it may appear.

The working portion of the lamp is well shown in Fig. 5. Here let *a* and *b* each represent a pair of magnets, having paraboloidal poles and armatures whose ends are shown at *c* and *d*, connected by the vibrating arm *e*, pivoted at *h*, and carrying with it the lever *i*, connected with the piston rod of a dash-pot *k*, and the clutch *m* holding the upper carbon holder *f*, which slowly feeds down, the lower carbon *g* being fixed in the usual way. The electrical contact of the upper carbon is made at the bearing *n*, and also through thin brush-shaped coppers at *o*. The positive connection at *p*, is made with the frame-work of the lamp, and after passing through the carbons, the current vitalizes the low resistance coil *b*, (3 ohms) and leaves the negative terminal at *g*. The coil *a*, is of 350 ohms resistance, having its circuit completed through a spiral adjustable resistance spring *w*, and forms a constant shunt, taking normally $\frac{1}{16}$ of the total current. As long as the arc remains of normal length and resistance, the coil *b* holds the armature *d*, and the clutch *m*, or if necessary attracts the armature more strongly and raises the clutch and carbon. When the arc lengthens and the resistance of the main circuit increases, the shunt magnet *a* draws the armature *c*, while that at *d* is released, relaxes its hold on the clutch *m*, and allows the carbon holder to feed. The dash-pot has an elongated piston head and uses air instead of liquid resistance. It is difficult to represent the exact action of the clutch, which is quite simple, consisting of a curved lever pivoted at one end and bearing midway a cam which grasps the holder. In case of an accident or the total consumption of the carbon, a greatly increased current through *a*, brings together the insulated contact springs *s*, and forms a low resistance circuit through a tripping magnet *t*, to the lamp frame. The attracting of the armature of *t* releases a powerful spring which throws up the holder of the negative carbon and completes the normal circuit, or, finding the upper carbon missing, leaves the lamp cut out. This tripping magnet is sometimes so placed as to allow the upper holder to fall. A hand switch *r*, extinguishes the light whenever desirable. This will be seen in Fig. 4.

Still another safety appliance, used on long circuits, is called the film cut-out, which will be readily understood when the high electromotive force is remembered. From each terminal of the lamp extends a wire ending in a small ball of metal. If these two balls be separated only by a thin film of paper the breaking of the lamp would occasion a sudden current pressure at this point strong enough to pierce the paper and close the line.

The lamp measures from 4½ to 5 ohms resistance when burning and requires 45 to 50 volts E. M. F. to give the standard intensity, 9 6 ampères.

The power required to give this current from the Thomson-Houston dynamo has already been noticed.

The arc is occasionally as short as $\frac{1}{16}''$, but usually $\frac{3}{32}''$ to $\frac{1}{8}''$ in lamps of 2,000 candles (nominal). Tests of these lamps by Professor Thomson show 1,750 to 1,800 candles actual photometric measurement.

A mammoth lamp has been tried, the light of which was estimated at 25,000 candles, and the crater of its positive carbon measured $\frac{9}{16}''$.

In lamps of ordinary size from 25 to 50 per cent. is apparently lost by the use of opal globes, a part of which is compensated for by the superior diffusion thus obtained. From the ordinary factory plant up to lines of seven miles these lamps work very satisfactorily. One circuit of the latter length is now being successfully worked in the Luray Cave, Va., using the ground as a return.

THOMSON'S DISTRIBUTION SWITCH.

In connection with this system is a unique arrangement for coupling any dynamos and lines into one circuit. Let the sides of a square represent a closed circuit. At several places cut the line and introduce V-shaped springs which will normally keep the circuit complete. A number of dots or lines in pairs may represent the terminals of outside wires.

Now, if a non-conducting plug with two brass surfaces connected with any pair of wires be wedged between any pair of springs that circuit will be introduced into the square and a dynamo similarly attached will give the current.

Thus with the greatest ease and speed may several dynamos and several circuits be connected in series, or in any desirable interchange be readily effected. Another recent arrangement connects the positive poles of any number of dynamos to an upper row of screw-cups and the negatives to corresponding posts in a second line some distance below. By bringing the positive wires of circuits to a row of single springs immediately beneath the positive dynamo posts and the negatives just above the dynamo similar terminals any combination can be quickly effected by single plugs.

THE OUTLOOK

for the Thomson-Houston Electric Co.'s system is most encouraging. It is but a few months since the first plant was started, and the favor which the light has secured is indicated by the fact that systems are in successful operation at Boston, Lynn, Lowell, Worcester, Fall River and Providence, that they are rapidly multiplying in the West, and that New York is about to witness the formation of a large company.

The principal manufactory of the Company has thus far been located at New Britain, Conn., with an agency at 3130 Chestnut Street, Philadelphia, for Pennsylvania, New Jersey, Delaware and the city of Baltimore. Foundations are now being laid in Lynn for a factory which will cover nearly an acre of ground, and will be devoted to the production of all machinery used in the system, employing when in full operation several hundred hands.

Though heretofore so little known abroad as to have entirely escaped the notice of James Dredge, in the preparation of his recent exhaustive work, "Electric Illumination," Prof. Thomson has protected his inventions by patents in England, France, Germany, Belgium and Canada, and steps will without doubt soon be taken to introduce the light in Europe. As the electrician of the Company he will enjoy every advantage for experimental work, and being even now but little more than thirty years of age, the best of his life is all before him, and affords promise of great usefulness in the field in which he has so enthusiastically labored.

NEW HAVEN.—The United States Electric Light Company have their system well established in New Haven, and are lighting several of the largest stores in that city. The plant consists of one handsome 200 horse power Harris-Corliss engine and eleven dynamos, all in superb working order. The machinery, shafting and belting is of the best that can be procured, and their system of connecting the power to the dynamos, excellent. Under the careful management of Mr. Farnham, the Secretary of the Company, some good lighting is being done in the City of Elms.

Amalgamation of Zinc for Batteries.

The usual method of amalgamating zinc plates for galvanic batteries consists in freeing them from oxide by means of acid, immersing them in mercury, and rubbing them with a hard brush. This method, however, has the disadvantages of only depositing a superficial coat of mercury upon the zinc, which is soon denuded by the acids of the battery, so as to require speedy renewal. An electrician connected with the French Department of Posts and Telegraphs has invented a new mode of amalgamation, which is reported to give good results. It consists in immersing the zinc, previously to the usual mercury bath, in a solution of mercurial salt, the composition of which is patented by the inventor. This immersion renders the zinc brittle, its fracture presenting a granular appearance, resembling that of dead silver as it is deposited by electro-metallurgy. This new molecular condition permits of the mercury penetrating the zinc, and filling up its pores, and thus forming an obstacle to attack by the acids of the battery. Besides overcoming the difficulties inherent in the usual method of amalgamating zinc, the new process has the advantage of preventing all useless consumption of the metal when out of circuit, and also of preserving a perfect constancy in the battery until the zinc is completely used up.

The latest novelty in railways is a plan just invented for the erection of an elevated railway which would combine at the same accommodations for a tube three feet in diameter, which would contain the pneumatic-dispatch, the gas pipes, the electric cables and the conduits for the wires of the telegraph and the telephone.

International Electrical Exhibition, Vienna, 1883.

The Italian ministry on public works will, according to official information, be concerned in the International Electrical Exhibition by exposing the telegraph administration, and the Danish Navy ministry by exhibiting new inventions in the department of torpedoes. Besides Russia the Wirtemberg government has now likewise appointed its representative, and will send to the exhibition of Vienna as such Dr. Dietrich, professor of electrotechnic at the polytechnic school in Stuttgart.

In order to facilitate the exhibitors of the interior and abroad the expedition of the exhibits to Vienna, passing the custom-house and forwarding them from the termini as well as sending them back after the close of the exhibition, the commission have authorized the well-known firm for international transports, Schenker & Co., in Vienna, who have got branch offices at Budapest, Bukarest, London, Munich, Prague, Tetschen on the Elbe and Trieste, as well as representatives at Antwerp, Hamburg, Mannheim, Paris and Rotterdam, to act as forwarding agents. The mentioned firm will take care of the custom-house manipulations respecting the exhibits from abroad, keep accounts of those goods which will be exhibited and sent back after the close of the exhibition, look after the storing of the packings during the time of the exhibition, and at length will give information to the exhibitors in respect to the necessary instructions referring to the expedition of the exhibits.

Galvanometer.

Dr. Frolich exhibited a torsion galvanometer, at a recent meeting of the Physical Society of Berlin, prepared in Messrs. Siemens and Halske's establishment, for measuring electricity mechanically, in which the deflection of the magnetic needle is indicated by the corresponding torsion of a spring whose constant expansion power is known. The torsion galvanometer was at first constructed for measuring the current of the large dynamo-electric machine fitted up in Ocker for copper electro-plating, and which at least resistance possesses a power of 800 amperes. Here it was impossible to employ either a dynamometer, owing to the irregularity of the mercurial contact, or a tangent compass, which has to be directly inserted in the main circuit. Hence measurement could be effected only by lateral closing, and as Dr. Frolich fully explained, the determination of the potential at any required number of points in the circuit, as rendered possible by the new apparatus, gives the data for ascertaining the electro-motor strength, the resistance, and the power of the current. He described in great detail the construction and adjustment of the new appliance, in which, after insertion of determined resistance in the lateral circuit, the number of volts can be read off, and from these the amperes and ohms determined in the simplest manner. The torsion galvanometer is prepared in two forms, vertical with a magnet suspended to a cocoa fiber, and horizontal with a magnet resting on an edge The latter form is intended especially for cases in which the apparatus undergoes no delicate manipulation.

The Cause of Evident Magnetism in Iron, Steel, and Other Magnetic Metals.

PAPER READ BEFORE THE SOCIETY OF TELEGRAPH ENGINEERS AND OF ELECTRICIANS, LONDON, BY PROF. D. E. HUGHES, F. R. S., VICE-PRESIDENT, MAY 24, 1883.

The extreme sensitiveness of the induction balance to all molecular changes in the structure of metals was remarked in my first paper on this subject to the Royal Society ;* and in the case of iron and steel it is most remarkable, as the addition or substraction of $\frac{1}{5000000}$ part, or the addition of the smallest iron filing to an already large balanced mass of iron, is at once rendered evident and measurable.

Possessing such an invaluable instrument of research, I was desirous of investigating the molecular construction of iron and steel, but at once I met with a difficulty, viz., that magnetism itself completely changed the character of any piece of iron under investigation ; consequently, finding no help or explanation of the effects produced from any accepted theories of magnetism, I was forced to investigate, by means of the induction balance, the whole question of magnetism as existing in the interior of a magnet, and to determine the particular structure for each case, such as neutrality and polarity.

In a recent paper to the Royal Society, upon theory of magnetism,† I described the use of and demonstrations obtained by the induction balance. In this paper I propose to confine myself to demonstrations that can be repeated without it, and whose effects can be observed by the aid of ordinary magnetic direction needles.

That magnetism is of a molecular nature has long been accepted, for it is evident that, no matter how much we divide a magnet, we still have its two poles in each separate portion, consequently we can easily imagine this division carried so far, that we should at last arrive at the molecule itself possessing its two distinctive poles, consequently all theories of magnetism attempt some explanation of the cause of this molecular polarity, and the reason for apparent neutrality in a mass of iron.

Couloumb and Poisson assume that each molecule is a sphere containing two distinct magnetic fluids, which in the state of neutrality are mixed together, but when polarized are separated from each other at opposite sides and, in order to explain why these fluids are kept apart as in a permanent magnet, they had to assume, again, that each molecule contained a peculiar coercive force, whose functions were to prevent any change or mixing of these fluids when separated.

There is not one experimental evidence to prove the truth of this assumption ; and as regards coercive force, we have direct experimental proof opposing this view, as we know that molecular rigidity or hardness, as in tempered steel, and molecular freedom or softness, as in soft iron, fulfill all the conditions of this assumed coercive force.

Ampère's theory, based upon the analogy of electric currents, supposes elementary currents flowing around each molecule, and that in the neutral state these molecules are arranged hap-hazard in all directions, but that magnetization consists in arranging them symmetrically.

The objections to Ampere's theory are numerous. 1st. We have no knowledge or experimental proof of any elementary electric currents continually flowing without any expenditure of energy. 2d. If we admit the assumption of electric currents around each molecule, the molecule itself would then be electro-magnetic, and the question still remains : What is polarity ? Have the supposed electric currents separated the two assumed magnetic fluids contained in the molecule, as in Poisson's theory ? or are the electric currents themselves magnetic, independent of the iron molecule ?

In order to produce the supposed heterogeneous arrangement of neutrality, Ampere's currents would have either to change their position upon the molecule, and have no fixed axis of rotation, or else the molecule, with its currents and polarities, would rotate, and thus be acting in accordance with the theory of De la Rive. 3d. This theory does not explain why (as in the case of soft iron) polarity should disappear whenever the exciting cause is removed, as in the case of transient magnetization. It would thus require a coercive force in iron to cause exactly one-half of the molecules to instantly reverse their direction, in order to pass from apparent external polarity to that of neutrality.

The influence of mechanical vibrations and stress upon iron in facilitating or discharging its magnetism, as proved by Matteucci, 1847, in addition to the discovery by Page, 1837, of a molecular movement taking place in iron during its magnetization, producing audible sounds, and the discovery by Dr. Joule, 1842, of the elongation of iron when magnetized, led De la Rive, in his remarkable "Treatise on Electricity," 1853, to give his theoretical views upon magnetism in the following remarkable words :

"The whole of the magnetic molecular phenomena that we have been studying lead us to believe that the magnetization of a body is due to a particular arrangement of its molecules, originally endowed with magnetic virtue, but which in the natural state are so arranged that the magnetism of the body that they constitute is not apparent. Magnetism would therefore consist in disturbing this state of equilibrium, or in giving to the particles an arrangement that makes manifest the property with which they are endowed, and not in developing it in them. The coercitive force should be the resistance of the molecules to change their relative positions."

Wiedermann, in 1861, gives a theory in which he admits the fluids of Poisson, or the elementary currents of Ampere, as the cause of polarity of the molecule, but believes that the molecules are turned in a general direction in the case of polarity, and that in neutrality, like Ampere's, the magnetic axes of the molecules are turned in all directions.

Maxwell, in his remarkable treatise on "Electricity and Magnetism," 1881, page 75, gives the following *resume* of Weber's theory:

"Weber's theory differs from Poisson's, in assuming that the molecules of the iron are always magnets, even before the application of the magnetizing force, but that in ordinary iron the magnetic axes of the molecules are turned indifferently in every direction, so that the iron, as a whole, exhibits no magnetic properties."

And again, page 429, Maxwell says he agrees with Weber's views, and that neutrality, or unmagnetized iron, has the axes of its molecules placed indifferently in all directions, and that the act of magnetization consists in turning all the molecules so that their axes are either rendered all parallel to one direction or, at least, deflected in that direction.

I have quoted these several theories which admit of the inherent polarity of the molecule, and in that respect they entirely agree with my own ; but the induction balance at once shows that they are erroneous in the most important part, for my researches have proved that neutrality is perfectly symmetrical, that there is no case of neutrality where the axes of the molecules are turned indifferently in all directions, and that we cannot obtain perfect neutrality except when the molecules form a complete closed circuit of attraction.

I believe that a true theory of magnetism should admit of complete demonstration, that it should present no anomalies, and that all the known effects should at once be explained by it.

From numerous researches, I have gradually formed a theory of magnetism entirely based upon experimental results, and these have led me to the following conclusions :

1. That each molecule of a piece of iron, steel, or other magnetic metal is a separate and independent magnet, having its two poles and distribution of magnetic polarity exactly the same as its total evident magnetism when noticed upon a steel bar-magnet.

2. That each molecule, or its polarity, can be rotated in either direction upon its axis by torsion, stress, or by physical forces such as magnetism and electricity.

3. That the inherent polarity or magnetism of each molecule is a constant quantity, like gravity ; that it can neither be augmented nor destroyed.

4. That when we have external neutrality, or no apparent magnetism, the molecules, or their polarities, arrange themselves so as to satisfy their mutual attraction by the shortest path, and thus form a complete closed circuit of attraction.

5. That when magnetism becomes evident, the molecules or their polarities have all rotated symmetrically in a given direction, producing a north pole if rotated in that direction as regards a piece of steel, or a south pole if rotated in the opposite direction. Also, that in evident magnetism we have still a symmetrical arrangement, but one whose circles of attraction are not completed, except through an external armature joining both poles.

6. That we have permanent magnetism when the molecular rigidity, as in tempered steel, retains them in a given direction, and transient magnetism whenever the molecules rotate in comparative freedom, as in soft iron.

EXPERIMENTAL EVIDENCES.

In the above theory the coercive force of Poisson is replaced by molecular rigidity and freedom ; and as as the effects of mechanical vibrations, torsion and stress upon the apparent destruction and facilitation of magnetism is well known, I will, before demonstrating the more serious parts of the theory, cite a few experiments to prove that molecular rigidity fulfills all the requirements of an assumed coercive force.

The influence of vibrations, torsion, or stress of any kind upon a magnetized steel or iron rod may be seen by striking with a wooden mallet rods of hard and soft steel, also hard and soft iron previously magnetized to a known degree. The tempered steel, owing to its molecular rigidity, will lose but 5 per cent., the soft steel 60, hard iron 50, and soft Swedish iron 99 per cent. of its magnetism, the amount of loss depending not so much upon whether the metal be steel or iron, as upon its degree of hardness and softness; and as hard steel requires far more power to magnetize it to the same force than iron, it is possible to imagine a steel so hard that its molecules could not rotate, and that consequently no magnetism could be manifested from a given inducing cause, whilst a perfectly soft iron would give the maximum effect, and instantly return to its previous state. From this we might in error suppose that soft Swedish iron could not retain its magnetism, and that its natural state would be zero, or neutrality. The apparent disappearance of magnetism, however, is here due to the extreme freedom of motion of its molecules allowing them at once to follow the comparatively feeble directing force of the earth's magnetism. We can demonstrate this by feebly magnetizing a rod of soft iron held vertically, so that its north pole is at the lower portion. Upon removing the inducing magnet, or electro-magnetic coil, we find that the rod retains a powerful north polarity; but if magnetized in a contrary sense, then we have only *traces* of magnetism left upon the withdrawal of the inducing cause. To succeed in this experiment, as in all others where soft iron is mentioned, we should use the best Swedish charcoal iron, thoroughly annealed at high temperature.

We find, again, that rods of steel or iron will lose far less magnetism when vibrated in the magnetic dip, or vertically, when their north poles are at the lowest extremity, than when horizontal, or still less than when their poles are contrary to those of the earth's field, and also that they will acquire their maximum magnetism from a given exciting cause when held vertically, as described, and the molecules allowed greater freedom of motion to obey the directing influence by vibrations, torsion, stress, or blows upon the iron. Any influence that would tend to give greater freedom of motion, such as heat or mechanical trepidations, gives a far higher magnetic force to the iron than could be obtained without these aids.

In order to render visible the effects of motion upon magnetism, we may take two glass tubes or ordinary phials of any length or diameter, say 10 centimeters in length by 2 centimeters in diameter. If we now put iron filings in these tubes, leaving about one-third vacant, so as to allow complete freedom in the filings when shaken, we find that each tube, when magnetized, retains an equal amount of residual magnetism, and that this all disappears upon slightly shaking the tube.

We are thus imitating the effects of vibration. But if in one of these tubes we pour melted rosin (in fact, any slightly viscous liquid, such as petroleum, suffices) we then render these filings more rigid, and then we can no longer produce by shaking, the disappearance of its residual magnetism. In pouring in petroleum we have apparently been introducing a strong coercitive force, but we know that it can only have the mechanical effect of rendering the iron filings less free to turn and so comparatively rigid. If we desire to see the effect of torsion we have only to shake the filings so that when the tube is held horizontally the vacant space is above, and rotate it slightly (but without shaking) about a horizontal axis. Its remaining magnetism instantly disappears upon rotation, although we evidently have not changed the longitudinal position of its particles.

A similar effect takes place upon a soft iron rod, for if we magnetize it and observe its remaining magnetism, we find that, upon giving a slight torsion to this wire, its remaining magnetism instantly disappears, a similar effect to that in the rotating tube of iron filings. But if the iron is rendered more rigid by hammering, or steel rendered hard and rigid by tempering, torsions or vibrations have but little effect, as in the case of the filings rendered rigid as above mentioned. Thus we have no longer need of an assumed mysterious coercive force to account for the retention of magnetism, for once knowing the mechanical qualities of iron and steel and their degree of molecular rigidity or hardness, we can at once predict their retentive magnetic powers.*

[*To be continued.*]

* "On an Induction Current Balance, and Experimental Researches made therewith,"—*Proceedings Royal Society*, March 29, p. 56, 1879.

† *Proceedings Royal Society*, May 10, 1883,

* "On the Molecular Rigidity of Tempered Steel," by Professor D. E. Hughes, F. R. S.—*Proceedings Institution of Mechanical Engineers*, pages 72-79, January, 1883,

The Electric Dynamograph, or Apparatus Registering the Work of Machines.

By M. C. Resio.

In a memoir presented to the Academy of Sciences, March 27th, 1882, I gave the description of an apparatus indicating the work of machines by means of a telephone, which, showing the torsion of the motor axle and its angular speed at the moment when the apparatus is examined, gives the elements necessary for calculating the work of the machine to which it is applied.

I have studied another apparatus which can register automatically, a curve of which the ordinates are proportional to the strain applied to the motor axle, and the abscissæ are proportionate to its angular speed. Hence the area contained between any two ordinates, the curve and the axis of the abscissæ gives the work of the machine in the time during which the diagram has been traced

The dynamograph is composed of two parts, the transmitter and the receiver or registrar. The transmitter consists in a very simple mechanical arrangement, adapted to the motor axis, and by means of which the torsion simply causes a ring fitting on the axle to slip in the direction of its length, so that its displacements may be proportional to its length. A metallic stem with a rectangular section is placed at the side of the ring parallel to the axle and receives between two small clips affixed to its middle a flat edge of

the ring, the plane of which is perpendicular to the axle. It follows that the stem must follow all the movements of the ring, and its displacements which are parallel to the axle are also proportional to the torsion. If to this stem we adapt an index, the point of which is above a fixed scale, its position shows at any moment the torsion and consequently the strain of the motor. The movements of this index are transmitted electrically, as well as the angular velocity, of the axle to the registering apparatus, which traces a curve, the ordinates of which are proportionate to its displacements from the zero or point corresponding to no torsion; the abscissæ are proportionate to the angular velocity.

The mechanical arrangement to effect this transmission is composed of a clock which directs each minute two electric currents into a circuit, so that the time which has elapsed between two consecutive emissions is exactly proportional to the displacement of the index, and consequently to the motor strain; this time is always less than sixty seconds.

In the receiver, that part of the mechanism which serves to register the torsion is also composed of a clock, which communicates to a cylinder, having in relief upon its surface the thread of a screw continually inked, a uniform rotary movement, so as to make a revolution in sixty seconds. This cylinder is not fixed upon its axle, but rests upon it with a gentle friction; hence it may be stopped without the axle ceasing to turn. At the first emission of the current directed into the circuit which connects the transmitter and receiver, the screw begins to turn; at the second emission a slip of paper, which uncoils slowly at a rate proportional to that of the machine, passing under and very near the thread of the screw, is brought sharply, by the action of an electro-magnet, into contact with the thread, and a trace of ink is made upon the paper. Since at the first emission another trace is produced upon the paper, it is evident that the distance of the two traces is proportional to the time elapsing between the two emissions of the current, and consequently to the torsion or to the strain applied to the motor axle. The first ink-mark is always producad at the moment when the rotation of the screw begins. As these marks follow each other very closely, the movement of the paper being slow, they form a right line parallel to the margin of the paper. The traces due to the second emission give rise to a curve, the co-ordinates of which will be the distances indicated above, and consequently will be proportional to the torsion and to the motor strain. If the speed at which the paper is carried along is proportional to the angular velocity of the axle, we shall have a curve showing the work of the machine to which the dynamograph is applied. Its mechanical arrangement for this purpose is very simple.—*Comptes Rendus.*

Plans for an Electrical College.

Prof. Elisha Gray, the celebrated electrician and inventor, has purchased the entire frontage between his residence on Laurel avenue and the railroad at Highland Park, Chicago, for the establishment of an electrical college and experimental laboratory, and he will, as soon as possible, begin the erection of a first-class building for the purpose, filled with powerful engines for generating electricity and heating purposes. His own house, the building itself, and Highland Hall, of which he is President, will be lighted by electricity and heated by steam from the same power.

This will be the most extensive enterprise of the kind in the country.

At the instance of M. Cochery, the French Minister of Posts and Telegraphs, an investigation has been begun by M. Ricolle to establish an absolute unit of light. The task is a long and hard one, to be sure. But some fruits have been produced and here are some of them: How does silver behave in solidifying? A bath of pure melted silver was placed under a thermo-electric pile connected with a mirror galvanometer. The radiation from the bath fell normally on the battery through an aperture in a double-walled screen kept clear and cool by circulation water. As the bath cooled the pile showed that the radiance slowly decreased until the instant just before solidifying, when there was a slight increase preceding the final one.

The meeting of the New York Electrical Society, June 1st, was one of unusual interest. The feature of the evening was a paper read by Mr. William Lachlan, electrical engineer of the Light and Force Company, of this city, on the subject of the "Faure Accumulator." Mr. Lachlan reviewed the history of the development of the Faure accumulator, or storage battery, from its discovery up to the present time. He is the gentleman who, in October, 1881, lighted a railway train by electric light for the first time in history. The train was a fast express running between London and Brighton, and it will be remembered the matter created a profound sensation in the scientific world, and was commented on extensively by the press of this country and England. It is also probably still fresh in the memory of most of our readers the success met with in lighting the steamship Labrador, of the French line, running between New York and Havre. This was early in the year 1882, when Mr. Lachlan first came to this country to introduce the Faure storage battery. The Labrador was the first steamship ever lighted by electricity, but now a great majority of the transatlantic steamers are lighted by the same means, and probably to Mr. Lachlan's signal success on these two occasions may be traced the rapid advancement in popular favor of the storage batteries of to-day.

The masterly manner in which Mr. Lachlan treated his subject evoked hearty applause from those present. He had on exhibition a few cells of the Faure storage battery, to which were attached two small electric incandescent lamps, a small electro-motor, and an electric pen, all of which were in operation simultaneously. The lamps gave out a beautiful light of remarkable brilliancy, and the motor generated power sufficient to run a foot lathe or a sewing machine.

At the conclusion of Mr. Lachlan's remarks, Mr. C. O. Mailloux suggested that perhaps Mr. Lachlan could enlighten the members of the society on the subject of the actions and reactions which take place in the cells of a storage battery, as nothing positive on the subject has yet been determined.

Mr. Lachlan stated his observations and views on the subject, but had not yet determined to his own satisfaction what action actually does take place.

Mr. John M. Pendleton, an electrician, of Boston; Dr. N. S. Keith, Mr. C. O. Mailloux, and Mr. L. L. Leggett, of the Brush Electric Light Co., of Cleveland, Ohio, each made some remarks on this important subject, but nothing definite was deduced, as there was some difference of opinion

After the discussion, President Small thanked Mr. Lachlan, on behalf of the society, for his able and valuable address.

At the next meeting, June 15th, Dr. N. S. Keith will address the society on "Electro-Metallurgy."

Eight new members were elected at this meeting, and the prosperity of the society is very satisfactory.

Dominion Telegraph Company.

At a special meeting of the shareholders of the Dominion Telegraph Company, this week, the vacancy on the Board of Directors, created by the death of the Hon. T. N. Gibbs, was filled by the appointment of Mr. Erastus Wiman, of New York. Mr. T. Swinyard, of Hamilton, formerly vice-president of the company, was appointed to succeed Mr. Gibbs in the presidency, the Hon. W. Cayley becoming vice-president in lieu of Mr. Swinyard. What a mockery these things are! This company, like the Montreal, has been gobbled up by the Northwest Company for nine hundred and ninety-nine years or thereabouts. Is a separate organization to be kept up all this time, or only until the vines are blighted and there is no more champagne?

Telephonic.

The Telephone in Sub-Marine Warfare.

Much has been said and written recently regarding the inefficiency of our navy, the lack of ships and the ease with which even a second-rate power, like Spain, for instance, could through her war vessels, lay our maritime cities under contribution. The ingenious landsmen who make these assertions are, it is charitable to believe, profoundly ignorant of the gradual perfection now being attained in the torpedo system by the application of electricity. A system of electrically connected torpedoes, now attracting much attention in England, is called the "McEroy," presumably because a Capt. McEroy claims to be the inventor, though as a matter of fact, he has only joined together the good qualities possessed by several other systems, all of which, save the telephone attachment, we would inform Captain McEroy, and a deluded English public, were in active operation some twenty years ago, during the American Civil War, otherwise known as the Rebellion. Inasmuch, however, as Captain McEroy has effected the construction of a very efficient if not very original system of torpedo warfare, we deem it of sufficient importance to explain its main features at least to that portion of the public which believes that only a powerful fleet can protect our harbors.

In this system of harbor or coast defence the whole of a group of moored torpedoes communicate with the station or shore by a single electric conductor. Along this, they continually telegraph evidence of their being afloat and in working order, and upon any one being struck by a ship it gives immediate notice of the fact to an observer on shore, who can, if he think fit, instantaneously explode the exact mine without losing any time in preliminary adjustment. Further, each torpedo can be electrically isolated from the rest and can then be tested so that the continuity of the electrical connections may be drtermined, or can be exploded without coming in contact with the ship, the destruction of which is desired.

The single electrical cable which is the midium by which the currents for producing these various effects are conducted, runs from the signal station on shore to a point in the channel or harbor near where the assemblage of torpedoes is situated and there enters a junction box. From this box there emerge as many conductors as there are torpedoes to be manipulated; one going to each, and by means of electrically controlled apparatus within the box any one of these conductors can be separately placed in connection with the main cable, or all may be coupled to it at once. At its further end each conductor enters a torpedo and passes successively through a telephone coil and a platinum fuse, and thence to earth. Over the telephone, instead of the usual mouthpiece there is placed a bell, or a box containing loose shot, which, under the influence of the rolling motion of the waves, continually makes a noise that can be heard in a telephone at the central station.

The fuse is a piece of platinum wire through which a current of moderate intensity can be sent without any danger of heating it, but which can be rendered red hot by a more powerful current when desired. The arrangement by effecting explosion by concussion consists of a weight held down to a seat by a spring, but not otherwise secured. When the case is violently struck this weight is displaced, and by its motion brings two contact pieces together directing the current from the telephone coil and directing it through an electro-magnet, which maintains the parts in the new position until the exploding current is transmitted or the current is reversed when the contact is broken by a spring.

The Western Union in Illinois.

CHICAGO, June 6.—In the quo warranto case against the Western Union Telegraph Company, a petition was filed to-day before Judge Gary, asking to have the case remanded to the Federal Court. The petition set out that the amount in dispute exceeds $500, and is a suit arising under the Constitution and laws of the United States, and particularly under the act of Congress of July 24, 1866, in reference to telegraphs. The suit is an attempt to deprive the company, a New York corporation, of the right to transact business in the State of Illinois. A bond was filed, in the sum of $1,000, and the case will be transferred to the United States Circuit Court.

The New Northwest and the Telephone.

GOSSIP FROM MINNEAPOLIS.

It requires no written expatiation to convince the business public that the future of the telephone is not circumscribed. Practically there is no limit to the development of the business, and what has not been done in the way of rendering, in the majority of exchanges, an almost perfect system, mechanically, by experiment and improvement, is being rapidly brought about by gradual amalgamation under the executive jurisdiction of men who have worked their way along through the short period of the telephone's career and made this particular science a study.

March first, the entire territory of Minnesota, Western Wisconsin, and all of Dakota north of the 45th parallel, prior to that date under the agency of the Northwestern Telephone Exchange company, passed under the control of the Lowell syndicate—a name with no strange sound to a telephone man's ears.

The new company retaining name and falling into the line of rapid improvement and development, instituted at the opening of the year by the retiring management. Mr. Arthur S. Temple, of Salem, Mass., and Mr. C. H. Denman, from the company's headquarters at Lowell, arrived early in March, and replaced the retiring superintendent, Mr. F. B. Jilson and cashier L. M. Towne.

March 1st the exchanges of the company included Minneapolis, St. Paul, Stillwater, Winona, Red Wing, Faribault, and Wabasha, representing, in even figures, 1,268 subscribers, together with a large number of private-line patrons, scattered throughout the towns, reservations, and grain farms of Minnesota and Dakota. It was the policy of the former officers of the company to sub-let territory for exchange purposes in the outlying districts.

Since the advent of present people territory leased under this plan has been repurchased and amalgamated. Fargo, Bismark, Grand Ford, and Mandan, in Dakota, and Moorhead, Brainerd, and Fergus Falls, in Minnesota.

Mankato, St. Cloud, and St. Peter, in Minnesota, will open for business during the present month.

Akin with all business variety in this section, that of the telephone holds its own.

Minneapolis and St. Paul together, since March 1st, have shown a net gain of over two hundred stations. This increase requires an enlargement of switching facilities at the exchange office. Four Western Electric switches, of the duplicate system, are expected to be in operation by July 1st at the Minneapolis office.

Extra-territorial lines connect Minneapolis and Stillwater *via* St. Paul, and lines connecting Minneapolis and Stillwater *via* White Bear Lake; St. Peter and Mankato direct, and Minneapolis with the summer resorts; Lakes Minnetouka, Calhoun, and Harriet are in course of construction.

Although seemingly isolated from the hum of Eastern activity, in this particular field, much can be expected from the new Northwest—the telephone and the general class of peaple who mingle with the discord and jargon of the silent carriers of speech.

Judge Ritchie, of Frederick, Md., has sixteen beautiful and accomplished daughters, only one of whom is married. This is what the French would call an embarrassment of Ritchies.—*Lowell Citizen.*

Telephonic.

Telephone Meetings.

ANNUAL MEETING OF THE BAY STATE AND THE BOSTON & NORTHERN COMPANIES —CONSOLIDATION BROACHED.

At the annual meetings of the above-named telephone companies, June 4th, a large number of stockholders were present, including Gen. Thomas A. Sherwin, general auditor of the American Bell Telephone Company of Boston; Morris F. Tyler, president of the Southern New England Telephone Company; Hon. D. B. Varney, president of the Granite State Company, and others. In reply to a question of Hon. Francis Jewett, President Ingham hinted at the project of consolidating all the New England telephone companies under management of the Lowell officers into one company, to be called the New England Telephone Company. This, he said, would be advantageous in many ways. The stockholders would know exactly what territory they were interested in, the stock would bring a more even figure in the markets, and present owners would find largely-increased opportunity for selling whenever they desired. It is probable that a meeting will be held soon to consider definitely this consolidation project. The following are details of the meetings:

BAY STATE.

The annual meeting of the Bay State Telephone Company was also held. There were represented in person and by proxy 4,100 shares. President W. A. Ingham presided. After preliminary business, officers were elected as follows: President, W. A. Ingham; Treasurer and Clerk, Chas. J. Glidden; General Manager, Loren N. Downs; Directors, W. A. Ingham, Chas. J. Glidden, L. N. Downs, Chas. A. Nichols, S. Herbert Howe, Theodore N. Vail, Francis Jewett.

The report of the Treasurer showed that during the eight months' existence of the corporation 1,086 subscribers had been added, making the whole number connected May 1st, 1883, 2,525. The ex-territorial business has nearly doubled, there being transmitted in April last 8,360 messages, an increase of 3,460 over September, 1882. Several miles of ex-territorial wires have been put in place, and now there is a direct set of lines from Boston to Massachusetts State line, which branch off and connect with nearly every important city and town in the State. The total net earnings for the eight months were $30,695 63, of which amount $23,800 has been paid out in dividends, leaving a balance of $6,895.63.

THE BOSTON AND NORTHERN.

At eleven o'clock President W. A. Ingham called to order. There were 4,003 shares represented in person and by proxy. The following officers were elected: President, W. A. Ingham; Vice-President, Dr. M. G. Parker; Treasurer and Clerk, Charles J. Glidden; General Manager, Loren N. Downs; Directors, W. A. Ingham, Charles J. Glidden, Loren N. Downs, Wm. H. Anderson, Freeman B. Shedd, Theo. N. Vail, O. E. Madden, Morris F. Tyler, M. G. Parker. The Treasurer submitted his report, by which it appeared that during the twelve months 1,503 subscribers had been added, making the total number connected May 1st, 1883, 3,160. Eight thousand ex-territorial messages were transmitted in May, 1882, and 12,308 during April, 1883. The net earnings for the year amounted to $69,239.03. Of this amount, $50,700 have been paid out in dividends, leaving a balance of $18,539.03. It is the intention of the managers to open up new exchanges in New Hampshire and Vermont the coming season, and to connect all principal cities and towns in these States by ex-territorial lines.

The Rogers-Cahoone Quarrel.

The so-called National Secret Telephone Company is organized under the laws of the State with a capital stock of $5,000,000. It is claimed their object is to supply telephonic communication over long distances, and to this end it has brought several patents, some of which the officers of the company declare promise complete success. The instrument which it is now using is the invention of C. A. Randall, who is vice-president and general manager of the company. Some time ago it bought the patent of J. Harris Rogers, but it has abandoned it in favor of Professor Randall's. Between Mr. Rogers and W. J. Cahoone, one of the directors of the company, there has arisen a controversy over the purchase of the Rogers patent. Mr. Cahoone said yesterday in regard to the dispute.

"The company is not using the Rogers telephone simply because it was found to be worthless. It bought the patent and paid for it and Mr. Rogers has no claim against the company in any way. The dispute between him and myself is already in the courts, by which it will have to be settled. That is not a matter in which the company is interested."

General Thomas Ewing confirmed this statement. He said: "I have very little to say in reply to the statements made about me by Mr. Rogers. This much I may say: That Mr. Rogers has no claim of any kind against me or the company. In the personal controversy between him and Mr. Cahoone neither I nor the company has the slightest interest. For some months there have been printed numerous advertisements which were designed apparently to compel the company or me to intervene in the settlement of this dispute. They have been abusive in their tone, but I have taken no notice of them and I do not purpose to do so now. Any one who walks across Broadway runs the risk of being bespattered with mud. That is my condition; I have fallen in with a mud-slinger who apparently is trying to blackmail me."

A Stroke of Lightning by Telephone.

A son of Wm. Walters, of North Williamstown, Oswego County, N. Y., was struck by lightning Monday morning, June 1, while listening at a telephone. It struck him on the side of the neck, passed down through his boot and into the floor. There is hope of his recovery.

Mrs. H. W. Blount was standing near the telephone at the other end of the line, but strange to say, was not injured.

It burst the instrument, tore off the window casing, passed across and out of the room.—*Oswego Palladium.*

An Enterprising Telephone Company.

THE HARTFORD OFFICES ENLARGED, AND REFITTED WITH IMPROVED SWITCH-BOARDS—A STORY OF GRADUAL GROWTH.

HARTFORD, June 9.—If Connecticut's capital city has been a little backward in introducing the electric light, she can at least claim the credit of being among the foremost of New England cities to take advantage of that marvelous little instrument, the telephone. It was first introduced here by a druggist named Isaac E. Smith (now deceased) who claimed to be the original inventor of the telephone exchange system. To be sure this claim has been very much in dispute, and it is not the purpose of this article to discuss it. At any rate Mr. Smith was the first to bring the telephone exchange into Hartford, and from the little seed he sowed has grown one of the most successful and admirably managed offices in the country.

Mr. Smith was bought out by Messrs. H. P. Frost and George Coy of New Haven, who organized what was known as the Hartford Telephone Company in the winter of 1878-79. They in turn sold out to the American Union Telegraph Company, who first began to reduce the service to some kind of system. Then the Western Union Company saw that there was money in the scheme and started an opposition exchange. For about six months there was some lively competitive enterprise, and then the whole concern was bought out by the Connecticut Telephone Company, with the late Marshall Jewell as its president.

At that time there were about 300 instruments in use in the city. But the change of management infused a new life into the business, and that number has been steadily increasing, till now there are over 900 instruments directly connected with the Hartford exchange, and the company have been compelled to enlarge their operating room. They moved this week into commodious new quarters, handsomely fitted up, and equipped with the latest scientific improvements. Their new rooms are on the same floor and in the same building as the old ones—the Trust Company's block—a handsome brown stone edifice, centrally located, and overlooking the business portion of the city. The operating room is a well-lighted apartment 50×20 feet. They employ twelve operatives and a force of linemen. The operating department is in charge of Mr. Daniel E. Smith, a young man for seven years in the employ of the Western Union Company in this city, most of the time in charge of the stock indicators, and a very competent young electrician. They have placed in new switch-boards, ten twenty-five wire sections and two seventy-five wire sections of the Western Electric Company's make, and with Baker's combination table. The inventor of this, Mr. E. B. Baker, is the superintendent of the Southern New England Telephone Company.

Heretofore they have been using the Bunnell switch, but they claim that the Baker invention has superior advantages. When an operator answers a call, the circuit is grounded through the transmitter. When the connection is made the circuit loops through, and the operator, in cutting in to ascertain if parties are through talking, does not throw a ground into the circuit. And then the manner of connecting is so arranged that if one operator disconnects at one end of the room, it does not leave the circuit open, as the call can come through the cord and enter the ground through the spring-jack or the bar through which connection has been made. Another advantage is that a line is never left open in the operating room; and if an operator should accidentally pull out a cord, the weight of the cord will carry the plug down to a spring, pressing it to a ground plate, and thereby grounding the line. It is impossible to leave one line open. Calls for connection from one operator to another are done by telepeone, thus doing away with loud talking or shouting in the room. The wires are all brought down from the cupola in twenty-five wire cables, and all wires are placed out of sight. They have six blank sections, to which the spring-jacks and annunciators can be added at any time, making a capacity of 800 wires for the Hartford office. They have sixteen out-of-town wires now in operation, connecting with all parts of the State and southern Massachusetts. They do a heavy inter-State business, which is constantly increasing, and the lines are used as far as Stamford for commercial purposes. The out-of-town section is on a raised platform at one end of the operating room, and the out-of-town operator acts as manager in the absence of the chief.

In the outside department the wires are nearly all strung over the house-tops, though there are some poles in use. One fifty-wire Western Electric cable runs from the central office to the depot In connection with the office is a time system, through which the time is given to several large jewelry firms, and a time-ball, similar to the one on the Western Union building in your city, is placed on the roof of the Trust Company's building. Then they have a night bank circuit for the use of a watchman, who is hired by several great banking institutions; and if any bank fails to respond to its regular call, a policeman is sent down there post-haste. In one instance a very bold robbery was prevented in this way.

In fact, the telephone company have made themselves an absolute public necessity. Their instruments are used in all the large business and banking houses and in many private families. Their charges are reasonable—$40 a year for business houses or $30 for private houses on a circuit wire, and $60 a year for a single circuit wire to any distance within one mile of the central office. The manager, Mr. George H. Coe, is doing his best to accommodate his patrons, and is well liked. The telephone company have worked hard for success. They are reaping their reward.

The Tropical American Telephone Company, Limited.

CAPITAL, $400,000.—40,000 SHARES, $10 EACH.—PRINCIPAL OFFICE, NO. 95 MILK STREET, BOSTON, MASS., U. S. A.

This company, organized in November, 1881, acquired from the Continental Telephone Company, of Boston (the assignee of Professor Alexander Graham Bell, Francis Blake, Watson, Anders, Roosevelt, Fuller, *et al.*), all telephonic rights formerly its property in Central America, United States of Columbia, Venezuela, British, Dutch and French Guiana, Chili, Peru, Ecuador and Bolivia, South America, and all the West India Islands, except Cuba (already ceded to the Cuban Company). By subsequent purchase this company obtained from the Continental Telephone Co. all its existing telephonic rights in the remaining countries of South America, including many valuable contracts with subsidiary companies, and now has the sole and exclusive right, for a term of years, to sell, lease and use "Bell" telephones, "Blake" transmitters, and all other telephonic apparatus manufactured by the American Bell Telephone Company, under patents owned or controlled by it in the United States and Canada, in the entire territory of South America, Central America, the West Indies and Mexico.

The company now becomes the source of supply to the following telephone companies already organized and doing business, viz.:

1. The Inter-Continental Telephone Company, controlling Central America, United States of Columbia and Venezuela. Principal office, No. 95 Milk street, Boston, Mass., U. S. A.

2. The West India Telegraph and Telephone Company, controlling Jamaica, Porto Rico, Hayti, San Domingo, etc. Principal office, Chillicothe, Ohio.

3. The Compania Electrica de Cuba, controlling the Island of Cuba. Principal office, 62 New Church street, New York City.

4. The Mexican Telephone Company, controlling the Republic of Mexico. Principal office, 5 Beekman street, New York City.

5. The Companhia Telephonica do Brazil, of Rio de Janeiro.

6. The Companhia de Telegraphos Urbanos, operating in Bahia, Pernambuco, Santos, Rio Grand, and elsewhere in Brazil. Office, Rio de Janeiro, Brazil.

7. The United Telephone Company of the River Plate, of Buenos Ayres, controlling the Argentine Republic, Uruguay and Paraguay. Principal office, Buenos Ayres, South America.

8. The West Coast Telephone Company, Limited, controlling Chili, Peru, Ecuador and Bolivia. Principal office, Valparaiso, Chili.

All orders for instruments and apparatus to be used in any of the above countries should be addressed to the company operating in that territory.

The Tropical American Company has established "Exchanges" in Barbadoes, and in other of the West India Islands, and will supply the "private line" telephone business throughout the entire territory now under its control.

Applications for territory, with exclusive right to use telephones, should be addressed to the company direct.

PRINCIPAL OFFICE:
95 Milk street, Boston, Mass.

OFFICERS AND DIRECTORS:
H. S. Russell, President.
J. H. Howard, Vice-President.
Chas. W. Jones, Sec'y and Treas.

DIRECTORS:
H. S. Russell, of Boston.
F. M. Delano, of New York.
Nathan Appleton, of Boston.
Chas. Williams, Jr., of Boston.
J. H. Howard, of Boston.
J. D. Haines, of New York.
Chas. W. Jones, of Boston.

STOCK TRANSFER OFFICE:
Long Branch Banking Company, Long Branch, N. J.
T. C. Morford, Cashier, Transfer Agent.

A Cable Repaired.

PANAMA, June 2.—The Central and South American cable, which was broken near Payta, on May 19, was successfully repaired yesterday, and is again in good working order.

A telegraph line has lately been established between Shanghai and Tientsin. It is now to be extended to Pekin, as the prejudice has been removed. Telegrams are to be forwarded either in French or in English. Yet there is a strict scrutiny to be kept by two mandarins. The duty of these officials will be to see to it that no messages will pass over the wires by which the State would be endangered.

The proficiency attained by the colored gentlemen who have charge of the hat-room in large hotels is often surprising, as they pass out hundreds of hats without a single mistake. A young man from Buffalo was so impressed with the performance at a New York hotel the other day that in a tone of respectful admiration he asked the phenomenon how he knew it was his hat. "Well, sah," was the brisk response, "I couldn't swar dat de hat was yourn, sah, I only knows it was de hat you guv me."—*Exchange.*

Atlantic Cable Business.

Mr. J. Pender, M. P., Chairman of the Direct United States Cable Company, speaking at a meeting of the Submarine Cable Trust the other day, said the existing Atlantic cables were probably able to perform three times the amount of work they are doing now, and that their capacity would be in excess of the requirements for some years. There was little fear of competition, he added.

This is all well enough from Mr. Pender's interested point of view, but other equally practical men take an opposite one. The latter prove their sincerity, too, by investing their capital in new and opposition projects.

HARTFORD.—On May 1st, Mr. Daniel S. Smith dissolved his connection with the Western Union Telegraph Company in Hartford, Conn., and upon an offer from President Frost, of the Connecticut Telephone Company, went into the operating room there, which by the way, had, from want of discipline, run down. Mr. Smith's early training and prompt business methods soon brought a well-regulated system out of what had before been partial chaos. The general spring house-cleaning materially affects substantial old New England, and found the exchange ready for extensive alterations and repairs. They have been completed, and thanks to President Frost and Mr. Smith, Hartford has a bright cheerful and elegant exchange, fitted up with the best Western Electric Switch boards, and tastefully decorated, it presents a handsome appearance.

BOSTON.—Mr. Loren N. Downs, General Manager of the Boston and Northern State of Maine and Southwestern Telephone Companies, has ordered from the American Spiral Telephone Company, sixty-nine miles of their new wire, and if found better than the ordinary telephone wire will order two hundred and fifty more. Mr. Gorham Gray is very sanguine over the ultimate results of the trial tests.

BOSTON.—The great Stanley, under patronage of James Gordon Bennett, explored, through labyrinths and jungle into the heart of Africa. Our friend Stanley, of the Bridgeport Brass Company, arrived some weeks since, after a circuitous journey through the labyrinth and jungled streets of Boston into the heart of the Hub, seeking patronage for the celebrated house he represents. He got it. Truly, the Stanleys are great when on exploring expeditions.

The "Hello!" "Hello!" of 3,000 Subscribers Received by Old Employes Under New Officers.

An unexpected change has occurred in the ownership and management of the telephonic interests in Texas and Arkansas, as will be seen by the contents of the circular of which the follwing is a copy:

EXECUTIVE OFFICE
SOUTHWESTERN TELEGRAPH & TELEPHONE COMPANY.

LITTLE ROCK, Ark., May 31st, 1883

To the Employes of the S. W. T. & T. Co.:

FRIENDS,—It has been universally conceded that the telephone facilities have been extended more rapidly in the territory of this company than in any other part of the United States. The great prosperity of the two growing States has, of course, aided this great telephone expansion, but even the notedly liberal people of this great Southwest do not patronize enterprises unsatisfactorily conducted. No other comment is needed to show that it is by your zeal and efficiency that you have won our admiration and heartfelt good wishes.

Yet circumstances have dictated that our relations should be changed. The active management of the affairs of the company will now be under the supervision of W. A. Ingham, president, and Loren N. Downs, general manager.

Your efficiency has been such that we would not have retired under circumstances that would leave any doubt of the recognition of your meritorious services.

We shall for the present remain in the directory, and as the active management will necessarily be under the control of the principal officers, it is proper that you should know that they are recognized as gentlemen of such high personal repute and such great prominence in the telephone field that no employe need fear but the new management will be such as to continue the good reputation of the company, and to merit the continued pride, loyalty and best efforts of all.

With renewed assurances of our high appreciation of, and good wishes for, you,

We are, respectfully,
LOGAN H. ROOTS,
J. N. KELLER.

The controlling interest of the company has been sold to what is known as the Lowell syndicate. The Southwestern Telegraph and Telephone Company controls the entire telephonic rights for the whole of the two States of Arkansas and Texas. While the largest exchanges are at Galveston, San Antonio, Dallas and Little Rock, yet there are, in all, twenty-three exchanges, all in operation, and three construction corps constantly at work in erecting other exchanges and connecting lines. The company, under the vigorous and liberal management of Colonel Roots and his associates, has astonished older sections of the country by the rapidity of the telephonic expansion, until now about 3,000 subscribers hello in its territory, and every person rejoices in the belief that their enterprise has not only well served the communities, but has comfortably filled the promoters' pockets.

Telephone transmitters should be painted "yeller."

There is so much sand in the strawberries that are brought to market now that they seem quite fit for the desert.

Correspondence.

RIO DE JANEIRO, May 11, 1883.

Editor Electrical Review.

DEAR SIR,—I send you a copy of the *Anglo-Brazilian Times* and one of the *Rio News*. You will find in these papers a notice of the granting, under the new patent law, of the telephone patents to Professor Alexander Graham Bell, through his attorney, Mr. C. P. Mackie; and also a notice of the transfer to the National Electrical Company (Companhia Nacional de Electricidade) of all the rights as to Brazil, formerly the property of the Tropical American Telephone Company and the Continental Telephone Company.

The District Telegraph Company (Companhia de Telegraphos Urbanos) lately organized to furnish district telegraph and telephone service, and now the exclusive license of the National Company for the province of Rio de Janeiro has received, in the short time since its organization, three hundred and fifty orders for telephone service in the City of Rio de Janeiro alone. This compares favorably with the record of the rival company, which, after three and a half years of service, has but little over five hundred subscribers.

The National Company proposes to push rapidly the establishment of exchanges throughout the whole empire.

Truly yours, D.

Bell and Indicator.

Editor Electrical Review:

SIR: Please inform us where we can obtain one of the pendulum indicators referred to on page 7, first column of the ELECTRICAL REVIEW of May 24th.

Respectfully yours,
J. REDDING & Co.
30 Hanover st., Boston, Mass.

ANSWER:

[Send to L. Clark, Muirhead & Co., Regency street, Westminister, S. W.—ED. REVIEW.]

Magneto-Electric Machine.

Editor Electrical Review:

SIR: I am constructing the above machine, such as are sold by opticians, but am at a loss to connect the ends of the wires of the revolving electro-magnet with the axle. Would you or some of your readers be so kind as to supply me with detailed instructions, and very much oblige

AN AMERICAN MECHANIC.

Newark, May 18th.

ANSWER:

[We will endeavor to supply this information in a later number.—ED. REVIEW.]

Parabola.

Editor Electrical Review:

SIR: How can I calculate focus of parabola? Has it any relation to proportion between the line drawn from point at which axis of generating cone cuts plane of parabola to apex of parabola and the line drawn on surface of parabolic section from same point to boundry at right agles to former line?

An early answer will oblige, very respectfully yours, EDEIRFLE.

Bay Ridge, L. I, May 20th.

ANSWER:

[The square of the ordinate, or line drawn perpendicular from axis to curve, divided by four times the abscis, or length of axis from vertex to that ordinate, is equal to focal distance from the vertex. Thus, suppose the ordinate to be 8, and the abscis 16, then $8\frac{1}{2}(16\times4)=64/64=1$, the focal distance required.—ED. REVIEW.]

Editor Review:

In your issue of May 24th the committee to whom was intrusted the selection of a system of electric lighting for the Brooklyn Bridge make the statement that Weston's system only uses an arc $\frac{1}{32}$ of an inch, while others use $\frac{1}{16}$ to $\frac{1}{8}$ of an inch. With the aid of heavily smoked glass I have studied the arc of several different systems, and must positively declare I never yet saw so small an arc as even $\frac{1}{16}$", and when the arc was that short the light was very feeble compared to the larger arcs. Is it not a fact that the size of the arc has much to do with the candle power of a lamp, the carbons being the same size? Is it not likewise a fact that to claim a system uses a small arc, is to admit that the candle power is relatively low? I have investigated the Brush, Fuller and Vandepoel arcs, and the Weston arc as used in Mobile, Ala., and in none of them have I seen so small an arc as the $\frac{1}{8}$ of an inch, consequently am puzzled at the claims of various systems to using these "homœopathic" arcs. Any information by letter or through your columns, if it is of general interest, will greatly oblige an admirer of the REVIEW.

Yours, &c., V. M. LAW.

Cedar Rapids, Iowa, May 29, 1883.

P. S.—In your journal you give the dimensions of things with metric system. Can you suggest some means of readily grasping this system, so that one accustomed to the old system will not have to stop and figure it out? I like it but it constantly bothers me till I have reduced it to the old measure. V. M. L.

ANSWER:

We will shortly publish a comparative table showing the English values of the French weights and measures. Our readers will find it convenient to cut this out and preserve it for reference while reading. We have instructed the members of our translating staff to translate the weights and measures in French articles into their equivalent English words, instead of referring to footnotes as hereafter.—ED. REVIEW.

Induction Coil.

Editor Electrical Review:

SIR: I should be glad to have your opinion as to which is the most effective way to dispose of 1 lb. No. 36 silk-covered wire in the construction of a small inductorium. Will greater length of coil, and, consequently, more convolutions of secondary, give better results than a short coil of a larger diameter, the same weight of wire (1 lb.) being in each? As regards the primary, would 16 or 18 be the best to use, and have three layers any advantage over two? Presuming that 1 lb. of 36 secondary, with a certain battery power, will give a 1-in. spark, will the addition of an extra ½ lb. of secondary give (with same battery) another ½ in. of spark? In what way does the induction action of the core contribute towards the efficiency of a coil? I suppose the presence of currents in the secondary is due in the greatest measure to induction from the "make and break" of the current itself in the primary, though I have read in an established authority that the secondary currents are due (entirely?) to the electro-magnetism of the core. If the core is removed altogether, have we not the secondary currents still, though to a less degree? What is the smallest coil it is advisable to build on the "disc plan"?

Will you kindly answer these questions at your leisure, and oblige

Yours very truly,
Boston, May 23d. A. Z.

ANSWER:

[Build secondary in two sections. Let the length be about three times the diameter when finished. Don't go beyond this, nor much below it. Either 16 or 18 will do for primary; 16, if nicely covered with silk, will answer very well, and two layers well and closely wound will do very well, but many would prefer three layers of 18. The essential point in primary is to wind as close, both in length and width, as you possibly can, to insure success. The core must be of thin iron wire, and should be capped with an iron-headed screw at the end nearest contact-breaker. The core and primary mutually assist each other, and, although you get an induced current in the secondary when no core is used, still there is no comparison as to when core is used and makes its own break.—ED. REVIEW.]

Electrical Review,

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We invite correspondence from Electricians, Inventors and the Telegraph and Telephone fraternity on matters pertaining to electrical and scientific subjects, and all facts of special interest in connection therewith.

We extend to manufacturers of electrical apparatus an invitation to send to this office any and all facts concerning their business which will be of interest to the public. We make no charge for publishing news.

Those desiring to recommend their goods can do so to any extent in our advertising columns, but we will not publish for pay anything of that nature in our reading columns.

Subscribers can at any time have the mailing address of their paper changed by sending both old and new address.

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No notice is taken of anonymous communications.

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The Toronto News Company, Toronto, Ontario, Canada.
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F. Knauff, Moscow, Russia.
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NEW YORK, JUNE 14, 1883.

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New Illuminating Gases.

As we have often said in these columns, we do not believe that the growing popularity of the electric light will, as some of our more sanguine contemporaries have declared, make the manufacture of gas profitless. On the contrary, we think that still more gas will be manufactured in the future than at present, but it will be used as a fuel and for heating purposes.

Nevertheless, we believe in looking things square in the face, not of pooh-poohing everything that is inimical to our interests, but, on the contrary, examining carefully into the matter with a view of forming a correct and intelligent opinion.

New processes for making illuminating gas are not, as a rule, remarkable for their economical success; but two of the more recently invented deserve a passing mention at least. One of these is a gas made from petroleum, water and air. In this case the generator consists of a cast-iron retort, so fixed in the body of a furnace that the heat is conducted both under and over it, the fuel being coke. The oil and water are fed to the retort through pipes, by drops, four drops of oil being fed in to one drop of water. As the oil and water are decomposed the resulting gas is led away through a pipe to a washer, and thence to the gas-holder where it is stored for use. As soon as a sufficient quantity of gas has been made and stored, the oil and water are turned off, and a jet of air is forced into the retort by means of a small blower. This air is also decomposed, and following the course of the oil and water-gas through the washer, finally joins it in the holder, having picked up on its way any gas remaining in the retort or in the washer. The air is added in the proportion of three of air to one of the gas already made.

The resulting gas is said to be of 21 candle-power, to possess the quality of permanence, and to cost only 37 cents per thousand cubic feet to produce.

In another process, the gas is produced from shale oil, which is introduced continuously, but in small quantity, into a double retort. At the mouth of the inner retort, the oil is injected by the aid of a jet of steam which is led from a boiler through a pipe passing through the furnace which heats the retorts, and by which means the steam becomes highly super-heated. The retort consists of two tubes of different diameters placed one within the other, and the formation of the gas is commenced in the inner tube. Flowing to the end of this, it returns along the outer tube through the annular space between the two, and is conducted thence to a washer in which the gas is simply passed through water and is then stored in a gas-holder for use, no purification except that of washing in water being necessary. The result is a gas which burns with a white light and which travels well. The cost of the gas is said to be about twenty-five cents per thousand cubic feet.

This sounds very well, and is calculated to make the average capitalist bring forth his money bags and exchange golden shekels for the company's stock. But the fact is that both of these gases, the manufacture of which has been described, are far more deadly to human life than the ordinary coal gas. How absurd then to prate of their economy! "What will it profit a man," asks the Scriptures, "if he gain the whole earth and lose his soul?" What will it profit a man, we should like to know, if he gets his gas for a mere song and loses his health? This is something many persons forget when they talk about cheap illuminating gas.

For many years our dwellings have been infected with poisonous vapors coming from the gas-pipes, and now every intelligent man and woman is looking for an illuminant that has not a taint of poison about it. Such an illuminant they will find in the electric light.

The Problem of Ærial Navigation.

He would not be considered of an unusually sanguine temperament who should, in these days, look forward to a not distant future of ærial navigation. For the perfection or rather the improvement of the storage battery has made that feasible which heretofore has been justly looked upon as of but doubtful promise.

It has been an easy matter to construct balloons of great buoyancy, but no one has thus far been successful in entirely controlling their movements when set free in the sea of ether above us.

The introduction of the storage battery into the problem, however, will tend, there is reason to believe, toward an early solution. So far the experiments of those interested in this subject, such, for example, as M. Tissandier, have been directed toward confirming the work of the storrage battery toward lateral propulsion and manœuvring; permitting gas to do its usual work of lifting the balloon.

There are, however, many well-devised plans for making gas and electricity combine with each other in perfecting a machine to navigate the air, and for a long time a project has been under advisement of bringing together in one spot the different persons interested in solving the problem of ærial navigation.

We are happy to be able to state that these plans have at last developed into something tangible and such a meeting is about to be brought about.

An æronautic exposition will be opened at Paris in the *Palais du Trocadéro* on the 5th inst upon the occasion of the celebration of the centenary of the discovery of important laws in ærostatics.

This exposition will comprehend, and examination of:

First. The comparative efficiency of various materials, such as silk, cotton, &c., for balloon envelopes.

Second. Gas balloons, captive balloons, free balloons and the Mongolfier balloon.

Third. The æroplane, the flying-bird machine and the parachute.

Fourth. Books, manuscripts, plans, photographs, designs and models having a bearing upon the subject in question.

Fifth. Instruments of observation for use in ærostatic, meteorological observations, barometers, thermometers, hygrometers and photographic apparatus.

Sixth. Apparatus for the generation of carbonic hydrogen and other gases.

Seventh The construction of light motors and gas and petroleum motors.

Eighth. The utilization of electrical apparatus as motors, also telephone, telegraph and electric light.

Ninth. Apparatus for correspondence by pigeon and by signal.

We believe that this exposition, which will be open for ten days, will lead, if not to the perfection of a practical flying machine, at least to impart results in the interesting science of ærostatics.

Sensible Gas People.

In the current number of the *Bulletin de la Compagnie Internationale des Téléphones* we find recorded the details of a very interesting movement about to be set afoot by the officers of the Paris gas companies. Of quicker perception and longer sight than our own gas people, these men have come to the conclusion that the atmosphere of the future will contain much electricity besides that generated through natural causes, and, taking the bull by the horns, so to speak, have determined to ascertain just what this quantity is likely to be.

In order to get at this they have established a laboratory in the Rue Piccini, where the apparatus necessary to a thorough testing of the various electric light systems is rapidly being collected. Careful examination will be made of electro-motive force, resistance to the current, capacity, and photometric tests will be made with the apparatus of Bunsen, Siemens, Halske, Napoli, Ayrton, and Perry, and others. Dynamo-electric machines, with accurate registers of the amount of electric energy recovered and applied, will be kept in motion continually by an eight-horse power gas engine of the Otto type.

This engine, we dare say, will prove quite powerful enough for these laboratory trials, and by which accurate results may be obtained with a small number of lamps.

In the quiet of the laboratory it will be possible to make comparative measurements of the various generators, independent of the lamps which they feed.

Like sensible men, however, the gent'emen having the experiments in charge will not be contented with simply measuring the loss of power in the current while *in transitu*, as exhibited at the end of the second machine. By no means. They are aware that in the steam engine less than twenty per cent. of the theoretical power of coal is recovered, and that the success of any contrivance requiring power does not rest upon how much may be lost or gained of the power used to work it, but rather upon the relative value of the power thus lost or recovered.

For this reason, therefore, since they have been directed to ascertain the true figures, and not merely to show the electric lighting is a failure, they will take into consideration the transmission of power between distant points.

The value of this cannot be over-estimated, as every electrician is well aware. The loss of power where an electric generator is worked by steam is, we will grant, a very important factor in the problem of economical electric lighting; but when the power of a water fall or running stream is being collected, a large percentage of loss may be sustained, and yet that which is in reality recovered prove profitable.

As the world knows now, M. Deprez has demonstrated that 32 per cent. of the power gathered from a running stream may be recovered at the end of 21⅛ miles. Without attempting to prognosticate the even better results which, there is good reason to believe, the future has in store, this is sufficient to make it apparent to the Parisian gas manufacturer that electricity is likely to prove a dangerous, if not successful, rival of the illuminating fluid in which he is interested.

How illogical, even childish, appears the behavior of our own gas people, when compared with that of their Parisian fellows. It may be likened only to that of the ostrich, who, when danger approaches, sticks his head into the sand, in the vain delusion that, since he cannot see what threatens, it will cease to annoy him, and disappear. He forgets that his great ungainly rump looms up broadly on the horizon, in full view, and that, because he cannot see his enemy, it is by no means an assurance that he is not at hand.

The child tightly closes its eyes at the vision of the bugaboo, and then, because it can no longer see it, sinks quietly to rest, with the full conviction that it is gone. So it is with our American gas companies. They employ experts to prove that electricity cannot compete with gas, and then, with a "Thank God!" sink back again into their wonted sense of security.

The results that are likely to be obtained, however, by the Parisian gas people, in the experiments about to be made in the Rue Piccini, will do much toward awakening them, and, we doubt not, they will soon be led to believe, what is a fact, that more light can be generated by using gas to drive an electric generator than if it were applied directly as an illuminant.

NEW ORLEANS, La., June 6.—Capt. Paul J. Marrs, of Nashville, and George L. Beetle, of Chicago, and their associates, yesterday completed the purchase of the property of the Louisiana Telephone Company. The officers of the old company retain their stock interest in the new combination. The new company intend to greatly enlarge the sphere of service, having in contemplation the building of a number of territorial lines connecting this city with the towns and cities throughout this State and Mississippi, and eventually with all Western cities, as well as with Texas.

Electrical Notes.

Like many others interested in the success of electric lighting, I have been pleased to observe that the ELECTRICAL REVIEW, which is the leading electrical authority in this country, has at all times evinced confidence in the ultimate triumphof the incandescent system.

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Each succeeding month brings with it additional evidence of the correctness of this view.

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It is not astonishing that the public should have, to a certain extent, lost confidence in incandescent lighting, for the public, having perhaps neither time nor opportunity to look carefully into innovations may always be set down as taking little interest in anything that does not produce immediate results.

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Now, incandescent lighting hereabouts may be said to have, so to speak, "hung fire."

***

Does this mean that it is a failure? By no means. It indicates only that the projectors propose to look before they leap, that in developing an entirely new system, they are wise enough to choose the most economical methods of arranging their plant and not be forced for the sake of an early installation, into putting fifty per cent. more money in their venture than is really required.

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Singularly enough, however, the Britons, usually slow to act, are about to take time by the forelock in the matter of incandescent lighting.

***

As is customary with them, however, they have waited until others—in this case, Americans—have, at great expense, worked out the problem, and now, having with their accustomed modesty appropriated the results, are about to go into the business themselves. *perfide Albion!*

***

As is well known the English electric-light people have had agents in this city watching the intelligent work of Mr. Edison in developing his incandescent system in that quarter of the city bounded by Spruce and Wall streets on the north and south, and Park Row, Broadway and the East River on the west and east.

***

As in the case of other American inventions, however, they seem, if the reports of their workings may be relied upon, not to have watched them long enough, for since they have appropriated Mr. Edison's system other and exceedingly valuable improvements have been made by him; and these, it would seem from the reports that reach me, do not enter into the so-called English system.

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Be that as it may, however, the "Telegraph Construction and Maintenance Company of England has given in a tender to the Corporation of Nottingham to supply them with an incandescent plant, consisting of distributing mains, generators, engines, boilers and buildings for an installation of 60,000 incandescent lamps.

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It may be assumed that this offer represents a genuine business project, designed to give satisfaction to the purchasers and a fair profit to the manufacturers, and does not, in any sense, partake of the nature of an advertisement to be afterwards used in the manipulation of the share market.

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It thus forms one of the most substantial pieces of evidence that has appeared, since Mr. Edison began the construction of his plant in this city, of what will be the cost of introducing the electric light on a tolerably large scale; and though it does not greatly differ from many estimates already published, yet it carries far greater assurance than most of these by reason of the fact that its authors are ready to enter into a binding contract to carry it out.

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As I have already said, however, the Briton has, with his accustomed stupidity, forgot to take advantage of—economically speaking—by far the most important factor in the Edison scheme.

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This is adjustment of the plant in such a manner that, when light is not needed—that is to say, during the day hours—power can be supplied over the same wires that supply the current for the light.

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The English company have adopted the Gordon generator, the leading feature of which is that the field magnets are mounted upon the periphery of a large wheel, which revolves between two sets of stationary armature coils.

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Unhappily for them, however, it produces alternate currents, and this I hold to be a great objection to its use for town purposes.

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The amount of electricity that will be expended in the production of power, when it is attached to houses, will rival that employed for light, and, up to the present, no motor has been devised that will work with alternate currents.

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Now, the introduction of domestic labor-saving machines has been almost prevented, but if a means of working them by power, as in the Edison system, were provided, without any danger or trouble from steam, gas or batteries, their number would increase by bounds, and the domestic motor would become as universal as the sewing or the washing machine.

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Edison's idea—and one, too, that there is a fair reason to believe he will be enabled to carry out—is of furnishing small manufacturers not only with light, but also with power—say, from one to ten-horse power.

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This would save them the cost of engine, fuel and engineer, and would give remunerative employment for the great engines, which, under any circumstances, must be kept in good running order, at the central station, and which otherwise would, during the day hours, lie idle.

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The installation at Nottingham is intended to furnish a continuous supply of a current of electricity, sufficient for the maintenance of 60,000 Swan lamps of 20-candle power each, for sixteen hours out of the twenty-four, and of one-third of that number during the remaining eight hours, to all the houses, warehouses, shops, factories, street lamps, etc., in a specified area.

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When the installation is complete, the contractors are to run it for thirty days at its full capacity, or as near that as the demands of the consumers will allow, and, if it prove successful, it is then to be handed over to the corporation, and the last installment of the purchase money is to be paid.

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The contract price is to be £220,000, or £3 13s. 4d the lamp, a lower amount than I remember to have seen quoted before; but it should be remembered that the plant is on a much larger scale than that of any previous project, and that the price does not include the cost of the site, or wires or lamps on the consumers' premises.

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In their estimate of cost, the English company calculated that one incandescent light will cost 18.6s. per annum, as against 31.25s. for a gas jet, with gas at 2s. 6d. the thousand feet.

***

The figures, excepting the lamp renewals, seem to be fairly estimated; it is not easy to calculate the repairs and depreciations of such a plant, but if the possibility of its being superseded by some other means, if generation be overlooked, 4½ per cent. does not seem to be an excessively small estimate, especially when it is remembered how much of the capital is sunk in buildings, foundations, and mains.

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The coal and labor would seem to be liberally allowed for, but an estimate of two shillings which the company makes for Swan lamps per thousand hours is a surprise. It either involves a much greater endurance than the 1,200 or 1,500 hours usually counted upon, or else a reduction of fifty per cent. upon the present price as quoted by the Swan company. As matters now stand, it must be raised to 3s. 3d., and this will add £9,370 to the annual charges and bring the cost per lamp to 21.6s.

***

Were I so bold as to hazard an opinion as to the result of this enterprise, upon the part of the Telegraph Construction and Maintenance Company, I should say that, with the present low charge for gas in England, the corporation would, until their plant got into good running order, lose money, though eventually even with the present price of gas there is reason to believe that money will be saved, while at the same time a far better illuminant than gas will be secured.

***

In America, however, with gas to small consumers at $2@$2.25 the thousand, it is easily seen that, if these figures are correct, consumers might readily be supplied with the beautiful incandescent light for the same price which now they pay for gas, and at the same time a good margin of profit remain to the projectors.

F. H. N.

The tallest electric mast in the country has been erected in Minneapolis, Minn. It is surmounted with eight lights, each with 4,000 candle power, which diffuse light enough to enable anybody within a radius of one mile to tell the time of his watch at night.

A 3,000-Mile Neck-and-Neck Race.

Ordinarilly the cable companies work in unison, now that their issues are pooled, but occasionally a circumstance will bring out the *esprit du corps* and a friendly rivalry ensues.

A case in point is the English Derby, the name of the winner of which each company strives to convey to this side of the Atlantic before the other.

The last Derby, held on the 23d ultimo, was not an exception, and the moment that the winner passed his nose under the wire the race between the cable companies began.

The direct company had an advantage in having a wire connection with the race track, but it met with a slight delay on the land wires which equalized the conditions of both companies, and "St. Blaise," the winner's name, was flashed into New York City by the two different routes at precisely the same moment, namely 10:13 A. M.

A Little Shooting Scrape in Mexico.

MEXICO, May 21st, 1883.

Editor Electrical Review:

Have just returned from a gunning trip of two days' duration, during which time fun was at a discount. The party from Mexico was composed of General Porfirio Diaz, General Juan Gutierrez, Senator Guillermo Landa y Escandon, and the writer. Sr. Don Alberto Torreros joined us at Jalpa, a station about 25 kilometers from the city. Sr. Pascual Fenochio, of Oaxaca, had taken one day's start, in order to arrange for our stay, and met us at the station of Dañú, where we left the cars at 10:30 A. M., 78 miles from Mexico. I must not neglect to mention our dogs—"Madho," a very good French setter, belonging to Sr. Don Terreros, and the writer's pointer, "Plucher," a recent arrival from the "States." As they had nothing to do, they performed their work well.

General Diaz and myself carried Greener hammerless guns, 10 and 12 gauge, respectively; General Gutierrez, his fine Pieper; Senator Escandon, a Scott; Srs. Terreros and Fenochio, good French guns; beside which could be seen sundry 45-calibre revolvers and blood-chilling bowie-knives, as "persuaders." We were also armed with huge baskets, from which protruded suspicious-looking black necks, usually wrung with a corkscrew, designed to keep the provender in its place in the packages, all of which were carefully looked after by the "mozos" (servants) who accompanied us. Baskets, gun-cases, etc., were packed on burros, and the procession moved majestically away, keeping step with the music furnished by a blind man torturing a mandolin. In the selection of saddle horses, I was very fortunate in securing a side-wheeler, the balance of the horses being trotters up to regulation speed, loping, which was out of the question most of the time, owing to the roughness of the trail.

After a ride of two hours over the mountains, through cactus of every known species, we halted on a table-topped mountain, where preparations were already under way for breakfast, chiefly the roasting of a calf, which was suspended on sticks over a hole-in-the-ground fire. The party started out for a half-hour shoot while table was being set, and returned empty-handed, a red fox being the only game sighted, and, judging from his speed, he was on a business errand of great importance, or practicing for a go-as-you-see-fit match. After a breakfast of roast veal, boned chicken, boiled eggs, rice, onions and tortillas, washed down with coffee, wine or pulque, we again started out, and succeeded in bagging five jack-rabbits. We then adjourned to a hacienda (farm-house) for supper and lodging. Supper over, we were shown our beds, which were made on the stone floor. Being somewhat fatigued, I soon fell into a sound sleep, to be suddenly awakened by a call to umpire a game of hide-and-seek, then in progress by genuine Mexican fleas, promenading over every inch of my manly person. Oh, such a game! It continued during the whole night, regardless of my frequent calls for "time," and I joyfully hailed daylight, in order to give the musquitos a chance. Coffee over, we again put out for a truly Mexican hare-chase, which I will now describe.

A native was captain-general of the party, assigning us to our several positions at 500 yards apart, more or less—a chain-guard, as it were, around the stone fence with which tracts of land varying from two to eight hundred acres were enclosed. The mozos, thirteen in number, well mounted, would then start on a skirmishing tour, with dogs in the van. When a hare was sprung, the troop of men and dogs would set up the most infernal yelling I ever heard, and chase the fur to one of the stone fence sentries, who would end his career with a charge of shot. Occasionally a hare would crawl through the fence, and then the beaters would give a breakneck race after him, and, with one exception, succeed in turning him back to the slaughter-pen. Four more hares were added to the bag, when we put in for breakfast at 11:30 A. M. The first course was roast *goat*, and it was very coarse. Then tortillas and pulque, as a matter of course. Also "Boston strawberries" (beans) *always*.

A tour of inspection about the place revealed a quaint old stone house, situated on a mountain about 8,000 feet high, surrounded by an organ cactus fence, the court filled with maguey plant from which is extracted the favorite drink, pulque. Apjoining the house, there is in course of erection a stone church of Gothic design, on the south side of the front of which there are nine square holes in the wall, three feet square and six feet deep, four feet from the ground, in which will be deposited the bodies of the members of the family, after they "cross the river." When a body is placed therein, the hole is securely closed by stone and mortar. In case there should be more than nine members in the family, they would remove the oldest back number corpse and give the latest edition a rest, I presume. I figured it so.

Around the grounds of the hacienda were many Indian huts built of round rust-col-

ored stone, no mortar used, four to six feet high, six by ten feet, roofed with straw, maguey plant leaves or debris, inhabited by natives, dogs, chickens, turkeys, pigs and fleas. 'Tis said that these Indians used the Turkish baths two hundred years ago. I believe the statement, excepting as to the time; judging from their appearance, it must have been two thousand years since; but as the rainy season has now set in, I have hopes of water reaching them occasionally. Yet they are contented and happy and the politest people on the globe, the very beautiful custom of lifting the hat in salutation, even away out in the mountains, never being omitted either to a stranger or their acquaintances. They also say their Spanish "good-morning, sir," and "good-bye, sir," in passing each other, all of which is worthy of imitation. I notice the some politeness in the city of Mexico, where *hack drivers* and street porters lift their hats in passing each other.

Owing to a scarcity of freight cars in which to ship our game to the city, it was decided to return home; we therefore ordered our caballos (horses) and at 12:20, P. M., put out for the station. We had some exciting sports on the way, my pacer usually winning. Notwithstanding the glory thus showered upon him, he was so ungrateful as to step on my left foot, slightly demoralizing that useful member. Some Indians followed us from the hacienda to the station, carrying the game, and arrived at the same moment. Their speed and endurance is wonderful. The "band" (blindman) was on hand as on our arrival the day previous, and treated us liberally. At 2.30 P. M., we once more boarded the comfortable American style coach, as run by the enterprising Mexican Central Railroad, and after passing through the beautiful Valley of Mexico, through Mochistongo drain, we arrived safely at home at 7.30 o'clock, all well satisfied with the trip and anxious to repeat it.

On day after to-morrow, I start on a week's trip to the Zimapan district, leaving the railroad at Tula, eighty kilometers from this city, and traveling thence one hundred and ninety kilometers on horseback to my destination through a wonderful country.

GEO. W. LARUE.

Mr. J. F. Martin, president of the Air-Chamber Wire Insulating Company is the inventor of a number of devices whose object is to overcome the obstacles in the way of underground telegraphy, and, if adopted, to do away with the overhead wire and pole business. In a terra-cotta or earthenware pipe he incloses a number of small tubes made of paper and asphaltum. These pass through and are supported by wooden or compressed discs perforated and set inside the main, about six feet apart. Through the small tubes, which are said to be perfect insulators, will run telegraph, telephone, and electric-light wires. A twenty-inch main will contain 1,105 wires, a twelve inch main 352 wires, and a six-inch main 62 wires, each of which will be wholly separated from the other wires. The mains will be laid underground, and can be made accessible by means of manholes, placed one block apart.

In the Far West they have a way of arguing which is thoroughly convincing. When a gentleman remarked, "Them hosses is a fine pair," a grammarian corrected him telling him that a more proper method of speaking would be to say, "Them hosses are a fine pair." The first speaker quietly pulled out a huge navy revolver, cocked it and then said, "Mister, it is perfectly correct to say, 'Them hosses is a fine pair.' Just you think the matter over and I'll give you two minutes or thereabouts to agree with me." Then the second speaker recalled the time when he kept a "deestrict" school and boarded round, and long before the two minutes were up he said:—"My friend, my deliberate opinion is that I was laboring under temporary insanity when I contradicted you. There ain't no finer specimen of pure English than the expression 'Them hosses is a fine pair.'" The gentleman with the revolver put up his weapon and blandly remarked, "I knowed you'd come to your senses when you took in all the circumstances."

People like to sing about reading their title clear to mansions in the skies, but they have no urgent desire to occupy those mansions and move out of an earthly home with a heavy mortgage on it. In nine cases out of ten they would prefer to have a clear title to a corner house on the avenue, and in the tenth case the man would rather live in a hired apartment here below than make any such radical change in housekeeping as is indicated by the song which he sings so rapturously.

Professor to a young-lady student—Your mark is very low, and you have only just passed. Young lady—Oh, I am so glad. Professor, surprised—Why? Young lady—I do so love a tight squeeze.—*College Exchange.*

Electric Lighting.

The *Manufacturers' Gazette* of Boston says that the idea that there is violent competition between the two systems of electric lighting, the "arc" and the "incandescent," is a mistake which grows out of ignorance of the subject. The fact is that each has its field, into which the other may not safely venture. The "arc" light, the first to come, is adapted for the economical lighting of large areas, such as streets, squares, warehouses, public halls, etc., any place where it is desirable to fill a large space with a flood of diffused light. "Incandescent" lighting, on the other hand, is suitable for lighting rooms and offices, and exactly takes the place of gas. In manufacturing establishments it is found in some cases that the one is preferable and in some cases the other, according to the nature of the work done, and the use to which the electric light is to be put must in all cases determine which system is to be employed. In France the Edison Company has made a number of contracts with the Government for the illumination of railroad stations. In each of these the stipulation has been for a certain number of arc lights for use in the train house and large rooms, and for a certain number of incandescent lights for use in the offices, waiting rooms, etc. In a word, a line has been drawn between the systems according to the use to be made of the lights. In the ordinary sense of the term they are not competitors.

The Faure-Brush Contest.

An interesting controversy is now pending in the Patent Office over the Faure secondary battery for the storage of electricity. The Brush Company and Professor Keith, who represents the Storage Company of New Jersey, are seeking to have the Faure patent set aside in their favor.

In December last the French Faure Company sent out several of their batteries to this country on the steamer Labrador, lighting the ship on its voyage from the stored electricity without the use of dynamos, the batteries being charged in France. Upon their arrival here the Faure Light and Force Company was organized, with William B. Whiting, of this city, as president. Four subcompanies were organized, a railway company, a New England and a Northwestern company, and one with headquarters in Baltimore. The Brush Company then published an announcement that it would bring suits against the Faure companies for infringement of Mr. Brush's device for storing electricity Later on the agents of the Sellon-Volckmar came to New York to introduce that device. Mr. Sellon is a member of the large metallurgical firm in London of Johnson, Matthey & Co. Volckmar was formerly a workman under M. Faure, and through him Mr. Sellon took up the manufacture of secondary batteries. A consolidation of the English and French companies as established here was effected under the name of the Faure-Sellon-Volckmar Accumulator Company. Its scientific representative is Professor Morton, of the Stevens Institute of Technology. A short time ago the interference suits of the Brush Company and Professor Keith were begun in the Patent Office and in retaliation the Consolidated Faure Company brought a suit at law against the Brush Company.

Incandescent Lamps.

Mr. C. F. Brush has patented a device by which he hopes to preserve the filaments of incandescent lamps from what has been called "molecular bombardment." He inserts a screen of mica between the legs of the filament, and thinks thereby to intercept the minute particles of carbon which are torn off and propelled from one leg against the other, a process which eventually weakens and aids in the destruction of the filament.

The Telephone in Paris.

On the first of this month the number of subscribers to the exchanges of the Societé Générale des Téléphones in Paris was 2,840. The number of calls per week at the same date had risen to 100,000. The number of subscribers to country exchanges was 4,460.

About $350,000 has been put into new enterprises at Southington, Ct., since last September. The foundations for the new britannia works are nearly laid. The main building will be 210x43 feet, the L 85x43. It will be two stories high and have a slate roof. The Ætna Match Company's building was expected to be raised by June 8. There will be two buildings 30x80 feet and one 30x50.

A Hartford (Ct.) company, with $50,000 capital, has organized under the Connecticut laws to utilize the Hoosac tunnel water-power, at North Adams, in manufacturing pulp from spruce. The president is Mr. W. T. Parks, and Mr. F. S. Lyman is secretary. The company will be known as the Glen Pulp and Paper Company, and it already has a mill built capable of turning out five tons of pulp a day, and controls seven hundred acres of spruce woodland. The water-power has been leased from the State government for several years.

There are 40,000 square miles of almost unbroken forests in North Carolina, comprising pine, chestnut, oak, maple, beech, and hickory timber in their finest growth. It is estimated that in ten years the timber alone in North Carolina will exceed in value the present total valuation of all the property in the State, including land. The State grows nineteen varieties of oak, and its pine forests are of the heaviest.

Another electric railway is building in Germany. It will connect Frankfort-on-the-Main with Offenbach, eight miles away, and the dynamos will be driven by steam engines stationed at a village half way between the termini.

A Change in the Proprietorship of the Louisiana Telephone Company.

Capt. Paul J. Marrs, of Nashville, and George L. Beetle, of Chicago, and their associates, on the 8th inst., completed the purchase of the property of the Louisiana Telephone Company.

Capt. John N. Bofinger, president of the company, W. H. Bofinger, vice-president and general manager, and W. W. Hock, secretary and treasurer, retain a stock interest in the new combination.

The new company propose to add many improvements, and hope to make the service satisfactory to the people of the Crescent City.

They have in contemplation the building of a number of "extra territorial" lines, connecting the city with the towns and cities in the interior. In fact, they have already commenced building a line to connect New Orleans with Baton Rouge, Port Hudson, Jackson, Bayou Sara and Woodville. This line will probably be extended to Vicksburg.

Many of the parties identified with this new enterprise are interested in the Cumberland Telephone Company, of which Captain Marrs is the general manager, and with the Evansville company, of which E. S. Babcock, Jr., is the president.

They are men of experience in the telephone business, and have been very successful with their several properties.

They bring energy and experience to this new field (new to them), and hope to demonstrate that they are worthy of the confidence and support of the people of Louisiana and Mississippi.

Production of the Precious Metals.

According to a special report of the Director of the Mint, the yield of the mines of the United States for the year 1882 was $32,500,000 in gold, $46,800,000 in silver; a total of $79,300,000. Compared with the previous year, this shows a decline of $2,200,000 of gold, and an increase of $3,800,000 of silver. The comparative decline in the production of gold was greater in California than in any other State or Territory, the yield being $1,400,000 less than in 1881. This resulted from the interruption of hydraulic mining in some of the northern and middle counties of the State, owing to litigation, and also from a falling off in the production of the quartz mines at Bodie. In Oregon, where the mining is chiefly placer, there was a diminution, and also in Nevada, Idaho and Dakota. In silver, the principal increase was in Idaho, Montana and New Mexico—Idaho showing an increase of $700,000; Montana, $1,740,000; and New Mexico, $1,500,000. Colorado furnished about $600,000 less silver than in 1881. The production of the country was from the States and Territories, as follows:

	Gold.	Silver.
Alaska	$150,000	.....
Arizona	1,065,000	$7,500,000
California	16,800,000	845,000
Colorado	3,380,000	16,300,000
Dakota	3,300,000	175,000
Georgia	250,000	.....
Idaho	1,500,000	2,000,000
Montana	2,550,000	4,370,000
Nevada	2,000,000	6,750,000
New Mexico	150,000	1,800,000
North Carolina	190,000	25,000
Oregon	830,000	35,000
South Carolina	25,000	.....
Utah	190,000	6,800,000
Virginia	15,000	.....
Washington Ter.	120,000	.....
Wyoming Ter.	5,000	.....
Total	$32,500,000	$46,800,000

In 1882 $9,939,975 was paid in dividends by incorporated companies; this was a slight falling off from the preceding year.

Mr. William P. Shinn has prepared for the report of the chief of the Bureau of Statistics a statement upon the increased efficiency of the railroad system of the United States, which shows that in three leading railroads—the N. Y. Central & Hudson River, N. Y., Lake Erie & Western, and the Pennsylvania railroads—the traffic increased during the decade ending 1880 from 2,682,603,465 ton-miles in 1870 to 8,265,038,412 ton-miles in 1880, or upward of 300 per cent. The means by which this enormous increase in traffic has been secured Mr. Shinn attributes to the following causes: First, improved track or "permanent way," including bridge superstructure—this is largely due to the adoption of steel rails; second, additional sidings and second, third, and fourth tracks; third, increased capacity and strict classification of locomotives; fourth, increased capacity of freight cars. Up to 1876 the standard capacity of freight cars was 20,000 pounds. In 1877 a few were built to carry 30,000, and since 1879 the standard cars, both of the East and West, have been built to carry 40,000 pounds; fifth, additional terminal facilities; sixth, improved methods of signaling embraced chiefly in the establishment of the "block system;" seventh, running locomotives "first in, first out," and running freight trains at a higher rate of speed; eighth, consolidation of connecting lines under one management, by purchase, lease, amalgamation, or otherwise; ninth, running freight cars through from point of production to tide water without transshipment; tenth, issuing through bills of lading from Western points of shipment to Atlantic and European ports

Manufacturing News.

The Armington & Sims Company, Providence, R. I., have shipped an 8½×10 engine to the Weston Edi-on Electric Light Company.

It is reported, from Vienna, that the firm of Messrs. Siemens & Halske have applied to the Austrian government for permission to undertake preparatory works requisite for the construction of electrical railways in that city.

A cubic inch of gold is worth $210; a cubic foot, $363,380; a cubic yard, $9,797,762. This is valuing it at $18 an ounce. At the commencement of the Christian era there was in the world $427,000,000 at the time America was discovered, when it began to increase. Now the amount of gold in use is estimated to be $6,000,000,000.

The Continental Underground Cable Company is the name of a new organization, with headquarters in Philadelphia, where the problem of getting the wires underground is seriously considered. It is organized under the New Jersey law, with $1,000,000 capital in 500,000 shares of $2 each, par value.

The system adopted seems to be similar to that employed in the successful tests at Chicago recently, with the additions of an electric motor or carriage to run on a track in the center of the conduit and carry a rope or wire by which the cables may be drawn into place, and a system of cables specially designed for telephonic purposes and supposed to avoid induction.

England, with 27,000,000 of inhabitants, has only 140,000 residents of foreign birth; Germany, with 45,000,000, only 270,000, while France with 37,400,000 has more than 1,000,000. In France there has been an increase of 200,000 in the last five years.

Too Much Electricity.

A lineman named Ferguson, employed by the telephone company, received an electric shock this morning that might have proved fatal if a companion had not been equal to the occasion and broken the circuit by cutting a wire. Ferguson was on top of a pole on the corner of Main street and Railroad avenue, and took hold of the wire known as the "power wire," which is connected with the fire alarm service. He grasped a telephone wire in the course of his work, thus establishing an electric current producing a sudden contortion of the man's nerves. He could not let go of the wire, and suffered terribly. His shrieks for aid attracted his companion's attention, who cut the wire in two or three minutes, thus liberating the sufferer.—*Meriden Press-Recorder.*

Messrs. E. and F. N. Spon, publishers and importers of scientific books, have removed to new and very commodious quarters at 35 Murray street. Their new store fronts on both Murray and New Church streets.

The Sub-Committee on Electrical and Mechanical Devices, of which Professor Henry Morton is Chairman, and Messrs. A. B. Chandler, J. P. Davis, F. H. May, H. W. Pope, G. S. Mott, Elihu Thomson and J. Elliott Smith are members, met at No. 115 Broadway to consider a report of the Secretary, Mr. Wm. C. Behrens.

Of the 400 patents examined special attention was given to those relating to means for removing the disturbing influence of induction, and the most important of these were reserved for more extended and careful consideration.

It was resolved, in order to stimulate and assist inventors, that an additional circular-letter be issued setting forth specifically the requirements of an inclusive system of underground communication.

Secretary Behrens reported that the committee's circular had been printed in three languages, and sent to every scientific and technical school, all great engineering firms and inventors, scientific societies, &c., throughout the civilized world.

The National Mining and International Exposition, at Denver, will open July 17 and close September 30.

In the Italian national exhibition, which, with the assistance of the government, will open in Turin during April, 1884, a special section will be set apart for electricity. The exhibition of electricity will open at the same time as the Italian national exhibition, and foreign exhibitors will be admitted there. In addressing to the electricians of all countries an invitation to take part in the Italian exhibition, and to show there, in company with Italian exhibitors, in the center of one of the most industrial provinces of the nation, the importance of the application of electricity to industrial uses, the committee has expressed the assurance that its invitation will be received with the consideration which it merits. The committee thinks that, if there is any country where industry can found great hopes on the applications of electricity, it is Italy, which, obliged to depend on foreign sources for coal for steam power and lighting, sees for the future, in its waterfalls and the torrents of its Alpine valleys, an inexhaustible source of motive power. The industrial interests in Italy show the desire to avail themselves of the great modern applications of electricity, and they will not miss an opportunity to adopt them.

The National Electrical Company, with headquarters in Rio de Janeiro, has been organized to construct, work and sell telegraphic and telephonic lines or other works or application of electricity or magnetism in the empire. The capital, which is fixed primarily at $100,000, in shares of $200 each, with power to raise to $1,000,000, was at once subscribed. The imperial government of Brazil, under the new patent law, has confirmed in that empire to Prof. Alexander Graham Bell his rights as the first and only inventor of "the method of and apparatus for transmitting vocal and other sounds by electrical undulations, commonly known as telephony." The Tropical American Company has transferred all its Brazilian rights to the National Electrical Company, which proposes to rapidly push the establishment of exchanges throughout the empire.

Mr. Chester D. Crandall and Miss Lizzie B. Long, of this city, were married at the residence of the bride's mother, 305 Twelfth street, at 3 o'clock yesterday afternoon, Rev. Cameron Mann officiating. Mr. Crandall is secretary and treasurer of the Missouri and Kansas Telephone Company, a young man possessing fine social and business qualities, and his wife is one of the many charming and educated ladies that Kansas City has attracted to her doors within the last year. The wedding was attended by the immediate friends of the bride and groom, who remembered the happy couple with numerous costly and beautiful gifts. Mr. and Mrs. Crandall left for the East on the evening train, and will spend a month visiting relatives and friends in New York and Boston.

F. B. Knight, general agent of the American Bell Telephone Company, is in the city on business for his company, and also to see that his friend Mr. C. D. Crandall was properly launched on the matrimonial sea.—*Kansas City Times.*

In his usual bright and racy style, Major La Rue tells us an interesting story incidental to his Mexican life.

Sydney Smith must have gone through a New York heated term when he wrote:—"If you hear of sixteen or eighteen pounds of human flesh, they belong to me. I look as if a curate had been taken out of me."

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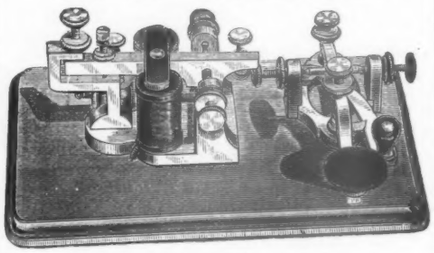

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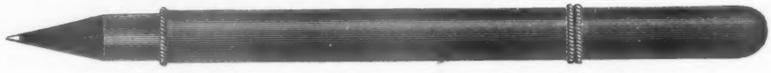

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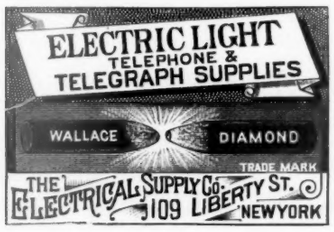

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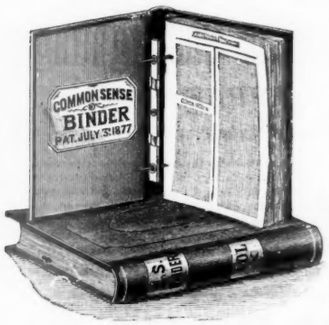

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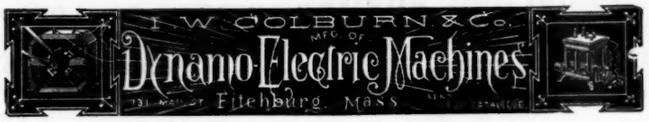

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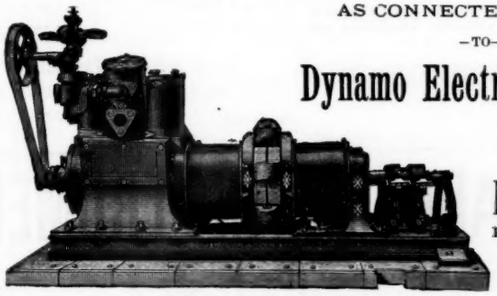

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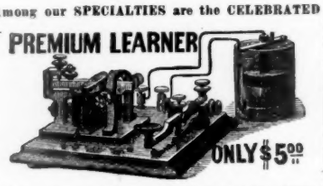

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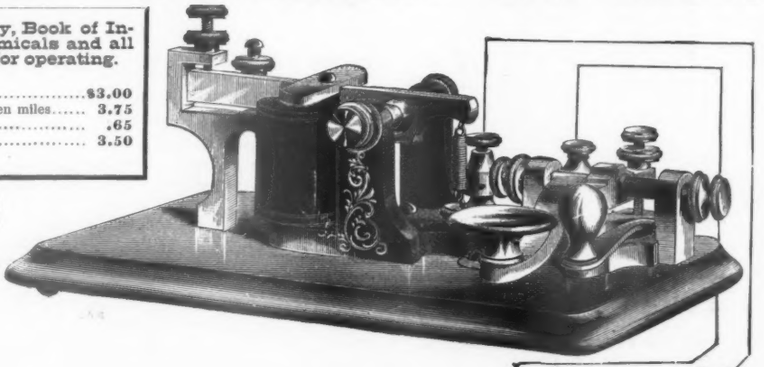

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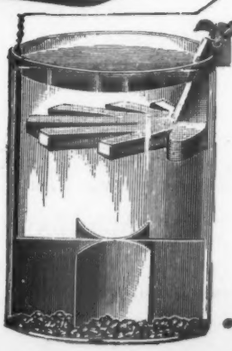

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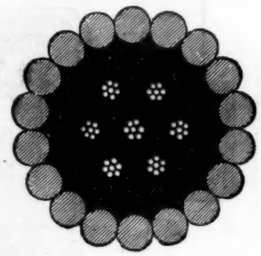

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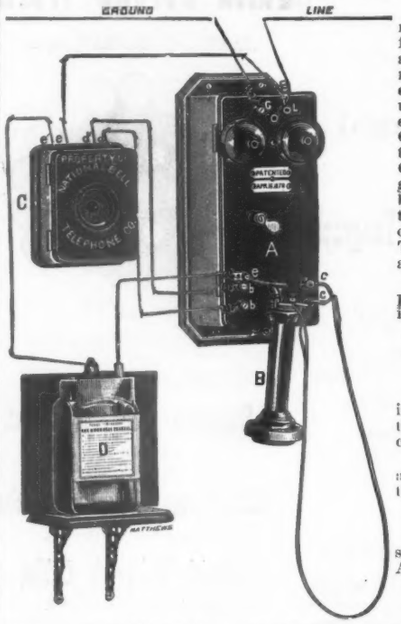

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